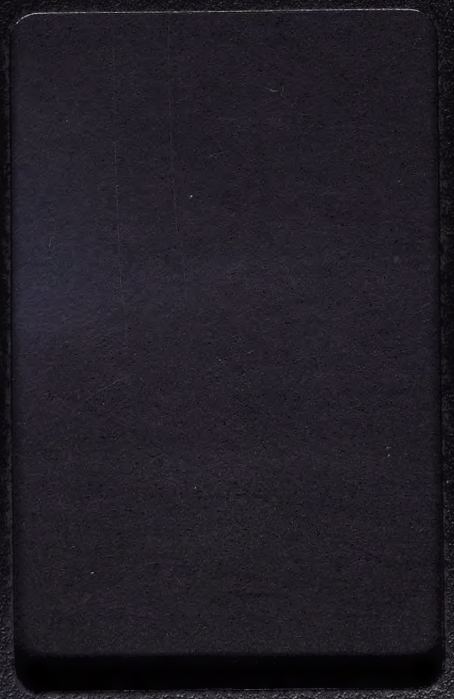
MOTOROLA INC.
Communications Sector

MOTOROLA "METRO-PAGE" 10/100 RADIO PAGING TERMINAL

USERS GUIDE

68P81021C35-O

INSTRUCTION MANUAL



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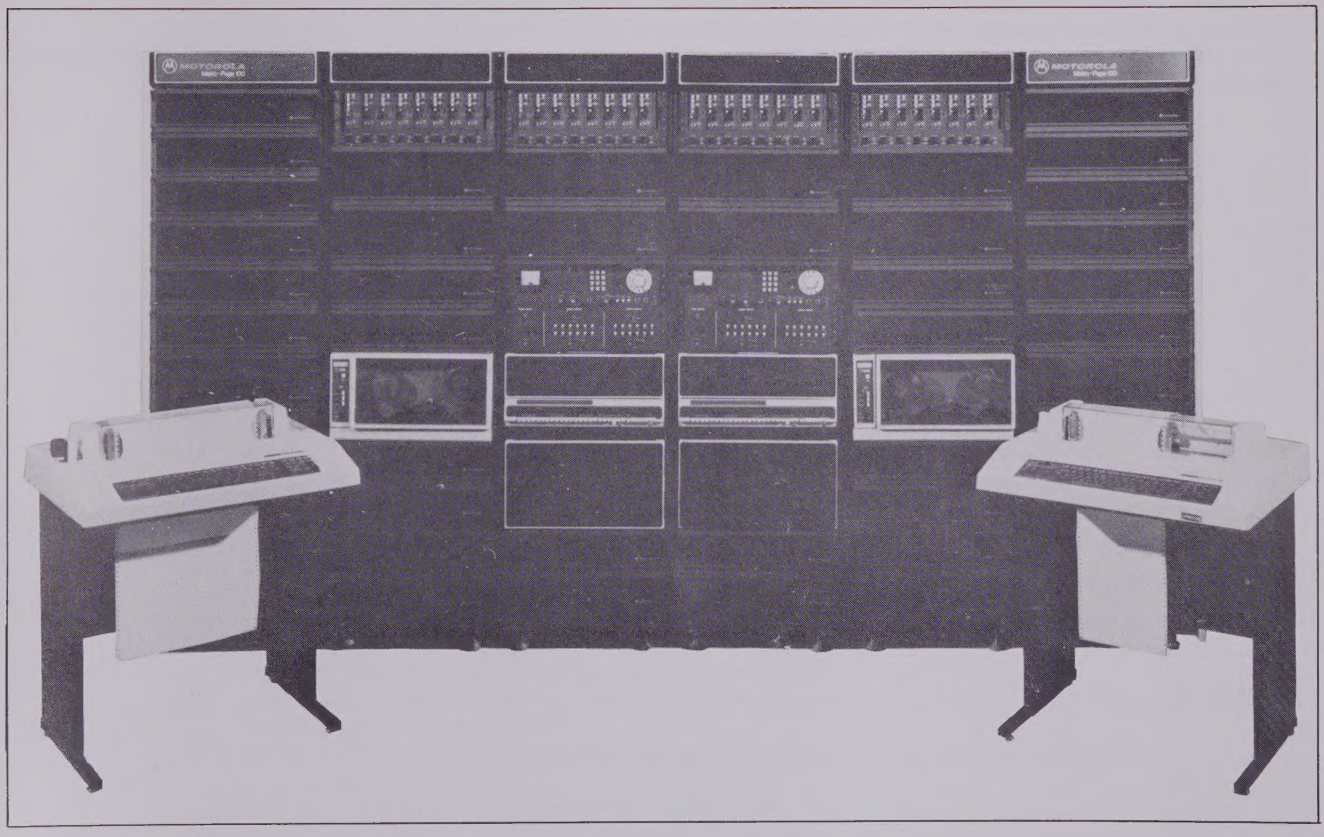

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FOREWORD

SCOPE OF MANUAL

This manual provides descriptive and instructional information for installation and maintenance of "Metro-Page" 10/100 type paging terminals.

PRODUCTION CHANGES

When minor production and engineering changes are incorporated into equipment, a revision number suffix is assigned to the kit affected (-1, -2, -3, etc.) and is stamped on the kit at the time of production.

INSTRUCTION MANUAL REVISIONS

Changes which occur after an instruction manual is printed are described in Instruction Manual Revisions. These bulletins give the reader complete information on the change, including pertinent parts list data.

RELATED OPERATING MANUALS

The following operating instruction manuals are to be used in conjunction with this installation and maintenance manual.

Manual Name	Motorola Reference Number
"Metro-Page" Standard 10-Redundant Operating Manual	68P81011C15
"Metro-Page" Standard 100 Operating Manual	68P81023C35
"Metro-Page" 10/100 Theory/Service Manual	68P81007C95

REPLACEMENT PARTS AND SERVICE

Motorola maintains parts and service depots and authorized service stations strategically located throughout the country. These facilities are fully equipped to give the finest service.

Be sure to include all identification numbers when placing orders or making inquires.

MOTOROLA INC.
Portable Products Division

"METRO-PAGE" STANDARD 10/100

RADIO PAGING TERMINAL

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PREFACE

This manual documents peripheral equipment and their support diagnostics that may or may not be supplied with your system. As the OEM manufacturer phases out or changes his product line, some items may become obsolete and unavailable from him. Consequently, items referenced in this all-inclusive document may become unobtainable as time passes. However, Motorola will provide support for the "as-shipped" configuration of your system.

Several items, included in this manual, are not currently supported by the OEM. Should you desire to integrate them into your system, the Fort Lauderdale Paging Terminal Marketing Department would be pleased to provide a quote via the Motorola Distribution Division. The devices are as follows:

- DL11 Asynchronous Line Interface
- TMB11/TS03 Magtape System
- TS03/TM8-E Magtape System

1. MANUAL GUIDE

1.1 INTRODUCTION

The "Metro-Page" 10/10R/100 Terminals are composed of a DEC PDP-11 computer, several types of peripheral equipment units, and the radio paging system hardware. The majority of the equipment is housed in racks and the keyboard/printer is a free-standing unit. Each unit is supplied with its corresponding documentation that, in general, describes operating procedures, theory of operation, maintenance, troubleshooting, etc. The following information has been assembled as a guide for the serviceman. A brief discussion of each manual, packed with the respective equipment follows.

1.2 BASIC SYSTEM MANUALS

1.2.1 PDP 11/05-S, 11/10-S System Manual #EK-1105S-TM

This manual provides the user with a general introduction to the PDP 11/05-S, 11/10-S computer. Topics discussed in this manual include include:

- A functional description of each of the basic computer system components. (Chapter 1)
- Installation information that includes the function of the controls, environmental, and electrical requirements; and installation procedures and certification. (Chapter 2)
- System operation information that includes the function of the controls and indicators of the programmer's console, basic system operation, and basic system programming. (Chapter 3)
- The instructions and the instruction set addressing modes. (Chapter 4)
- A general overview of the power supply, and the interconnections to the logic backplanes of the computer. (Chapter 5)
- A general overview of system expansion broken down into three types, SPC, System Unit, and expander box. (Chapter 6)
- General maintenance information including mechanical assembly preventive maintenance, maintenance diagnostics, and a list of the required maintenance equipment. (Chapter 7)
- Pin and signal designations for the serial communications line (SCL) interface, console cable, and the Unibus cable/jumper. (Appendix A)

1.2.2 KD11-B Processor Maintenance Manual #EK-KD11B-MM

This manual describes the KD11-B processor, the basic component of the PDP 11/05-S, 11/10-S computer systems. Connected to the Unibus as a subsystem, the processor controls peripheral time allocation of the Unibus, and it performs arithmatic and logic operations thru instruction decoding and execution. Topics covered in this manual include:

- Micro programming, the implementation, the memory, and the word structure. (Chapter 2)
- The theory of operation of the console logic. (Chapter 3)
- The logic and physical implementation of the processor data path, the data path control, Unibus control, serial communications line, and the line clock. (Chapter 4)
- Techniques for isolating and repairing failures in the processor and the console. Methods used to determine if the processor or the remainder of the computer has failed. (Chapter 5)

1.2.3 BA11-K 10.5 Inch Mounting Box Technical Manual #EK-BA11K-TM

The manual describes the general specifications, installation, theory of operation, and maintenance procedures for the mounting box. Included topics are:

- Characteristics and specifications. (Chapter 6)
- Unpacking and installation. (Chapter 2)
- System units, options, and harnesses.
- Mechanical and detailed circuit description of the mounting box and its contents.
- Maintenance and replacement procedures for failed items in the power supply.
- Installation, description, and maintenance information for each regulator module. (Appendices A-F)

1.2.4 BA11-K Mounting Box Illustrated Parts Breakdown #EK-BA11K-IP

This manual provides a parts list and a keyed assembly drawing of the mounting box for replacement parts ordering.

1.2.5 MF11-UP Core Memory System Maintenance Manual #EK-MF11U-MM

The core memory maintenance manual provides the user with the theory of operation and logic diagrams necessary to understand and maintain the core memory. Included topics are:

- Physical description and function of the memory including a brief description of the major functional units and the basic memory operation. (Chapter 1)
- A discussion of the M8293 timing module, which is sub-divided into memory protection circuits, operational mode selection logic and control logic. (Chapter 2)

- A discussion of the MM11-U memory, that includes the core array, switches drivers, current generation, static discharge circuitry, and sense/inhibit circuitry. (Chapter 3)
- A detailed discussion of the MF11-UP parity memory and the M7259 parity controller. (Chapter 4)
- A section that details the preventive and corrective maintenance procedures that pertain to the MF11-U/UP memory. (Chapter 5)
- A final section provides the data sheets for the IC's used in this memory system. (Appendix A)

1.2.6 H720 Power Supply and Mounting Box Manual #EK-H720-TM

This manual describes the PDP11 power supply, system configurations and installation procedures. Topics discussed are:

- Theory of operation. (Chapter 2)
- Mounting box model variations. (Chapter 3)
- Installation and physical description of PDP11 systems. (Chapter 4)

1.2.7 H720-D12 Power Supply and Mounting Box Users Manual #EK-H720-OP

This manual provides information for the power supply, mounting box, and their system configurations and installation procedures. Included topics are:

- General power supply description. (Chapter 2)
- General mounting box description. (Chapter 3)
- Installation procedures. (Chapter 4)

1.2.8 DR11-C General Device Interface Manual #EK-DR11C-TM

The general-purpose interface, between the Unibus and a peripheral, provides for parallel transfer of data. The manual describes:

- A general description that provides the user with an overview of the interface which includes a physical description and specifications. (Chapter 1)
- A software description that discusses the internal components of the interface. (Chapter 2)
- A discussion of the user I/O signals that control or are controlled by the peripheral device connected to the interface. A pin-out of the cable connectors is included. (Chapter 3)

1.2.9 DR11-C General Device Interface Users Manual #EK-DR11C-OP

This manual describes the general device interface used to parallel transfer 16-bit data between the PDP-11 and a peripheral. Topics that are covered in the manual are:

- General/physical descriptions and specifications. (Chapter 1)
- Software interface and use of the various registers. (Chapter 2)
- User I/O signals and cable connections. (Chapter 3)
- Applications. (Chapter 4)
- Use of blank mounting panel. (Appendix A)

1.3 OPTIONAL EXPANDED SYSTEM MANUALS

1.3.1 DC11 Asynchronous Line Interface Users Manual #EK-DC11-OP

An overall description of the DC11 interface is described in this manual. Included topics are:

- General and functional descriptions and specifications. (Chapter 1)
- Installation. (Chapter 2)
- Operational Programming. (Chapter 3)

1.3.2 DL11 Asynchronous Line Interface Manual #EK-DL11-TM

The asynchronous line interface utilizes a UART to provide a simultaneous (both transmit and receive) serial communications link to/from peripheral devices. Data is converted to/from parallel information used on on the PDP11 Unibus. This manual describes the serial interface and includes the topics:

- Specifications, data format, physical description, and operating specifications. (Chapter 2)
- Installation, configuration, and cabling. (Chapter 3)
- Programming information. (Chapter 4)
- Detailed theory of operation. (Chapter 5)
- A detailed theory of operation is provided that describes address selection, interrupt control, control status register, and the input and output buffer registers. (Chapter 4)
- A maintenance section that describes the procedure used to check out the interface. (Chapter 5)
- Additional sections describe a typical interface to peripheral hook-up, conventions used on the engineering drawing set, an IC data sheet, and information for the use of the BB11 blank mounting panel. (Chapter 6)
- IC data sheets. (Appendix A)
- Interrupt vector addressing. (Appendix B)

1.3.3 DL11 Asynchronous Line Interface Users Manual #EK-DL11-OP

Introductory, installation, and programming information necessary to understand and operate the DL11 interface is included in this manual. Additional topics include:

- A general description of the interface that discusses the five options, the data format, a functional description, a physical description, and specifications. (Chapter 2)
- Configuration, installation, and cabling information. (Chapter 3)
- Software control of the interface that describes the device registers, interrupts, timing, and a program example. (Chapter 4)
- Vector addressing. (Appendix A)

1.3.4 DB11-A Bus Repeater Manual #EK-DB11A-TM

The bus repeater allows the Unibus to physically expand beyond its 18 unit load capability. When installed, the bus repeater effectively doubles the length of the Unibus which can then handle up to 36 unit loads. The bus repeater is fully detailed in the manufacturers literature. Topics include:

- Functional description and specifications. (Chapter 1)
- Installation planning. (Chapter 2)
- Detailed theory of operation. (Chapter 3)
- Maintenance. (Chapter 4)

1.3.5 TMB11/TU10W DEC Magtape System Maintenance Manual (TMB11-E/F System) #EKTMBEF-MM

This manual provides in-depth information for the TMB11/TU10W magtape system. Topics that are covered in this manual are:

- System configuration, physical description, functional description, and specifications. (Chapter 1)
- Unpacking, installation, and acceptance testing. (Chapter 2)
- Operating instructions. (Chapter 3)
- Care and preventative maintenance. (Chapter 4)
- System maintenance. (Chapter 5)
- TMB11 theory of operation (Chapter 6)
- M8926 theory of operation. (Chapter(.Chapte)
- TU10W host transport theory of operation. (Chapter 8)
- Magtape fundamentals. (Appendix A)
- System diagnostics. (Appendix B)
- Flow chart symbols. (Appendix C)
- M8926 interface signals. (Appendix D)
- TMB11/TU10W data sheets. (Appendix E)

1.3.6 TU10 DEC Magtape Illustrated Parts Breakdown #EK-TU10-IP

This manual provides an illustrated parts breakdown for the various assemblies of the TU10.

1.3.7 TU10 DEC Magtape Maintenance Manual #EK-TU10-MM

This manual provides the information necessary to maintain the TU10 magtape unit. Included topics are:

- General description, magnetic tape fundamentals, and technical characteristics. (Chapter 1)
- Installation. (Chapter 2)
- Operation. (Chapter 3)
- Theory of operation. (Chapter 4)
- Cleaning, preventative maintenance, and replacement procedures. (Chapter 5)

1.3.8 TU10 DEC Magtape Users Manual #EK-TU10-OP

This manual describes the TU10 magtape system. It provides a general description of the equipment and how to operate it. Included topics are:

- General description including technical characteristics. (Chapter 1)
- Installation. (Chapter 2)
- Operation and equipment care. (Chapter 3)

1.3.9 TMB11/TS03 DEC Magtape System Maintenance Manual (TMB11-M System) #EKTMB11MM

The manual provides a complete description of the magtape system that includes installation instructions, operation, programming, functional descriptions, preventive and corrective maintenance, and removal and replacement procedures. The manual is divided into three parts; part I contains system information, part II contains controller information, and part III contains transport information. Included topics are:

Part I
- General information. (Chapter 1)
- Installation and acceptance information. (Chapter 2)
- Operating instructions. (Chapter 3)
- Preventive maintenance. (Chapter 4)
- System maintenance. (Chapter 5)

Part II
- Theory of operation, controller. (Chapter 6)

Part III
- Magtape fundamentals. (Appendix A)
- Diagnostics. (Appendix B)
- Cleaning instructions. (Appendix C)
- Interface signals. (Appendix D)
- Illustrated parts breakdown. (Appendix E)

1.3.10 TMB11/TSO3 DEC Magtape System Users Manual #EK-TMB11-OP

Magnetic tape systems provide the user with a method of permanent mass storage of digital information. The TMB11/TSO3 interface directly with a PDP11 computer. The users manual describes the following:

- System configuration, physical description, functional description, and specifications. (Chapter 1)
- Unpacking, installation and acceptance testing. (Chapter 2)
- Complete operating instructions. (Chapter 3)
- Care and preventative maintenance. (Chapter 4)
- Fundamentals of magnetic tapes. (Appendix A)
- A complete parts list. (Appendix B)
- Cleaning instructions. (Appendix C)

1.3.11 TS03/TM8-E DEC Magtape System Maintenance Manual #EK-T3TM8-MM

This manual provides a complete description of the magtape system that includes installation instructions, operation, programming, functional descriptions, preventative and corrective maintenance, and removal and replacement procedures. The manual is divided into three parts; part I contains system information, part II contains controller information, and part III contains transport information. Included topics are:

Part I — System Information
- General information. (Chapter 1)
- Installation and acceptance testing. (Chapter 2)
- Operating instructions. (Chapter 3)
- Care and preventative maintenance. (Chapter 4)
- System maintenance. (Chapter 5)
- TM8-E/TS03 control test, part 1. (Appendix A)
- TM8-E/TS03 control test, part 2. (Appendix B)
- TM8-E/TX03 data reliability, 9-track. (Appendix C)
- TM8-E/TS03 drive function timer. (Appendix D)
- TM8-E/TS03 utility driver (Appendix E)

Part II — TM8-E Controller
- General information. (Chapter 6)
- Block diagram description. (Chapter 7)
- Programming information. (Chapter 8)
- Detailed logic description. (Chapter 9)
- TM8-E interface and internal signals. (Appendix F)
- Spare parts. (Appendix G)
- IC descriptions. (Appendix H)

Part III — TS03 Transport
- General information. (Chapter 10)
- Theory of operation. (Chapter 11)
- Logic descriptions. (Chapter 12)
- Parts identification. (Chapter 13)
- Signal descriptions and interface information. (Chapter 13)
- Signal descriptions and interface information. (Appendix I)
- DEC/Vendor TS03 transport part numbers. (Appendix J)

1.3.12 LA36/LA35 DECwriter II Maintenance Manual

1.3.12.1 Volume I — #EK-1LA36-MN

This manual provides the information necessary to install, operate, and maintain the DECwriter II. Included topics are:

- General and functional descriptions, physical and technical characteristics, and options. (Chapter 1)
- Installation and checkout. (Chapter 2)
- Operating the terminal. (Chapter 3)
- Theory of operation. (Chapter 4)
- LA36 upgrade options. (Chapter 5)
- Electrical servicing. (Chapter 6)
- Mechanical servicing. (Chapter 7)
- Adjustment procedures and lubrication. (Chapter 8)

1.3.12.2 Volume II — #EK-2LA36-MN

This manual provides additional information for the DECwriter II. Included topics are:

- A discussion of the upgraded LA36. (Chapter 9)
- The compressed font option. (Chapter 10)
- The forms control option. (Chapter 11)
- The selective addressing option. (Chapter 12)
- The auto-answerback option. (Chapter 13)
- Forms control, vertical and horizontal tabulation option. (Chapter 14)
- Auto-line feed option. (Chapter 15)
- Expander option. (Chapter 16)
- EIA interface option. (Chapter 17)
- 20 mA interface cable option. (Chapter 18)
- Acoustic coupler option. (Chapter 19)
- APL option. (Chapter 20)
- M7728 print set. (Chapter 21)

1.3.13 LA36 DECwriter II Illustrated Parts Breakdown #EK-OLA36-IP

This manual provides exploded views and parts lists for the various assemblies of the unit.

1.3.14 LA36/35 DECwriter II Users Manual #EK-LA3635-OP

The LA36/35 are interactive data communications terminals. The terminal consists of a keyboard and a printer. Each terminal (LA35 and LA36) is discussed in the users manual. Included topics are:

- Options, model variations, jumper configurations and specifications. (Section 1 or 2)
- Use of the operator controls and indicators. (Section 1 or 2)

- Installation and checkout guide. (Section 1 or 2)
- Option controls and indicators. (Section 1 or 2)
- Setup and operating procedures for the options. (Section 1 or 2)
- Installation and checkout of the option kits. (Section 1 or 2)
- Paper loading and ribbon changing. (Section 3)
- Interface information and specifications. (Section 3)
- Programming information. (Section 3)
- Operator care. (Section 3)
- Troubleshooting guide. (Section 3)

1.3.15 PC04/PC05 Paper Tape Reader/Punch #EK-PC405-MN

The paper tape reader/punch provides a convenient method via punched paper tape for producing a permanent data or program record, in addition to providing a method for data or program entry. The DEC document describes this equipment; included topics are:

- General/functional description and specifications. (Chapter 1)
- Installation. (Chapter 2)
- Operation. (Chapter 3)
- Principles of operation. (Chapter 4)
- Maintenance. (Chapter 5)
- Diagnostic programs, stall programs, and set-up procedure. (Appendicies A thru D)

1.3.16 PCO5 Paper Tape Reader/Punch Illustrated Parts Breakdown #DEC-PCO5-IP

This manual provides exploded views and parts lists for the various assemblies of the unit.

1.3.17 Roytron 500 Series Reader/Punch Mechanisms Servicing and Parts Information #ER-00015

This manual is the companion to the DEC Reader/Punch manual. It contains information for the mechanical portion of the paper tape punch. Included topics are:

- Mechanical parts list. (Section 1)
- Electronic theory of operation including electronic parts list. (Sections 2 and 3)
- Preventive maintenance. (Section 4)
- Mechanical theory of operation and adjustments. (Section 5)

1.3.18 Model DMS-11 Disc Controller

The disc controller provides the interface between the PDP-11 computer and the hard disc memory. Topics discussed in the maintenance manual include:

- General and functional descriptions; and characteristics. (Section I)
- Installation. (Section II)
- Theory of operation. (Section III)
- System Diagnostics. (Section IV)

1.3.19 Model 6000X Head-Per-Track Disc Memory Systems Operation and Maintenance Instructions #1111

The disc memory provides mass non-volatile data storage for the system. The disc memory is described in the Digital Development Corporation documentation. Included topics are:

- General, physical, functional, interface, and option descriptions; and a list of specifications. (Section I)
- Installation and handling. (Section II)
- Theory of operation. (Section III)
- Maintenance. (Section IV)
- Troubleshooting. Section V)

1.3.20 CZQXALO XXDP Users Manual #AC-9093L-MC

This manual describes the DEC PDP-11 diagnostic software packages supplied with your terminal. The software package includes a monitor that provides keyboard control for loading programs, and update program that provides the means for modification and updating the software packages, a copy program used to copy software from one device to another including core, and a text editor that is used to create and edit ASCII test files.

The manual supplies the following information:

- Introduction. (Chapter 1)
- General use documentation. (Chapter 2)
- Update programs. (Chapter 3)
- Text editor program. (Chapter 4)
- Copy programs. (Chapter 5)
- Resident monitor commands. (Appendix A)
- Resident monitor errors. (Appendix B)
- Update commands. (Appendices C and D)
- Peripherals supported by update programs. (Appendix E)
- Peripherals supported by copy programs. (Appendix F)
- Program naming conventions. (Appendix X)

1.3.21 CXQUABO DECX11 Users Manual #AC-F053B-MC

This manual provides the user with information about the Run Time Exerciser (RTE). This diagnostic is used to test the hardware and detect rather than isolate any problems. Topics discussed in the manual include:

- A system overview. (Chapter 2)
- Exerciser build and run procedures. (Chapter 3)
- A sample program. (Appendix A)

1.3.22 CXQUBCO DECX11 Cross-Reference Manual #AC-F055C0-MC

This manual supplies the user with all of the information necessary to construct a Run Time Exerciser (RTE). Topics include:

- The definition of the naming standards and conventions for the software. (Section 1)
- Information required to use the cross-reference data in this manual to build an RTE. An example of a pre-build plan is included. (Section 3)
- Supplementary information. (Section 4)
- A sample build RTE. (Appendix A)
- Error codes. (Appendix B)

2. EQUIPMENT KIT STRUCTURE

2.1 INTRODUCTION

"Metro-Page" 10 and 100 Radio Paging Terminals are computer-controlled automatic terminals designed for use within high capacity metropolitan paging networks. "Metro-Page" 10 Terminals can service up to 10,000 paging subscribers; while "Metro-Page" 100 Terminals can service up to 100,000 subscribers or more. These paging terminals accept inputs from either dial-pulse or end-to-end telephones in a citywide or inter-city network; interpret the incoming subscriber number; and encode a paging call to a selected subscriber or group of subscribers. The terminals can encode paging signals which are compatible with all Motorola paging method types — standard two-tone; sub-audible two-tone; decimal digital (five-tone); dual function decimal digital (DFDD); or binary digital.

"Metro-Page" 10/100 Terminal configurations subdivide into three general family types — "Standard 10"; "Standard 10-Redundant"; and "Standard 100". Table 2-1 defines the operational/functional characteristics associated with the three family types; while Figure 2-1 illustrates the principal hardware items involved.

2.2 "METRO-PAGE" STANDARD 10 TERMINALS

"Metro-Page" Standard 10 Terminals include:

- Up to 24 input data sets (one per input line.) A dial input data set is used with each dial pulse (selector-level) type input line; an end-to-end data set with each end-to-end type input line.
- A PDP11/05 computer with core memory. The basic configuration contains 16K words of core memory sufficient for handling up to 4000 subscribers; with the core memory expansion accessory included (28k total words of core) up to 10,000 subscribers may be accommodated.
- Up to three input units to interface with the computer's control and data bus (up to eight line interface sets per input unit, where each line interface set — "LIS" — is composed of a data set plus a corresponding input register).
- An appropriate computer software package
- A local teletypewriter
- One or more dual function decimal digital (DFDD) or binary output unit(s). (Maximum of five total output units.)
- One or more DC, tone, and/or binary transmitter control unit(s). (Maximum of 24 total transmitter control units per output unit.)

2.3 "METRO-PAGE" STANDARD 10-REDUNDANT TERMINALS

A "Metro-Page" Standard 10-Redundant Terminal may be either factory supplied or field-configured

Table 2-1. "Metro-Page" 10/100 Terminal Characteristics

	SOFTWARE PREFIXES	PAGING METHOD	NO. OF INPUT LINES	NO. OF XMTR GROUPS CONTROLLED	SUBSCRIBER MEMORY CAPACITY	REMOTE TELETYPE-WRITER CAPABILITY?	REDUNDANT CONFIG.?
STANDARD 10 AND STANDARD 10-REDUNDANT TERMINALS	RDUN10	five-tone; two-tone; subaudible two-tone; dual function decimal digital ("DFDD") —individually or in combination	up to 24 (Standard 10); up to 24 redundant (Standard 10-Redundant)	up to 80	up to 10,000	YES (up to 8 remote users and teletypewriters)	YES (Standard 10-Redundant); NO (Standard 10)
	RBIN10	binary digital					
STANDARD 100 TERMINALS	STD100	five-tone;two-tone; subaudible two-tone; dual-function decimal digital ("DFDD") binary digital— individually or in combination	8, redundant (basic) up to 160 redundant	1 (basic) to 80	75,000 (basic) to 100,000 +	YES (up to 15 remote users and 8 teletype-writers)	YES

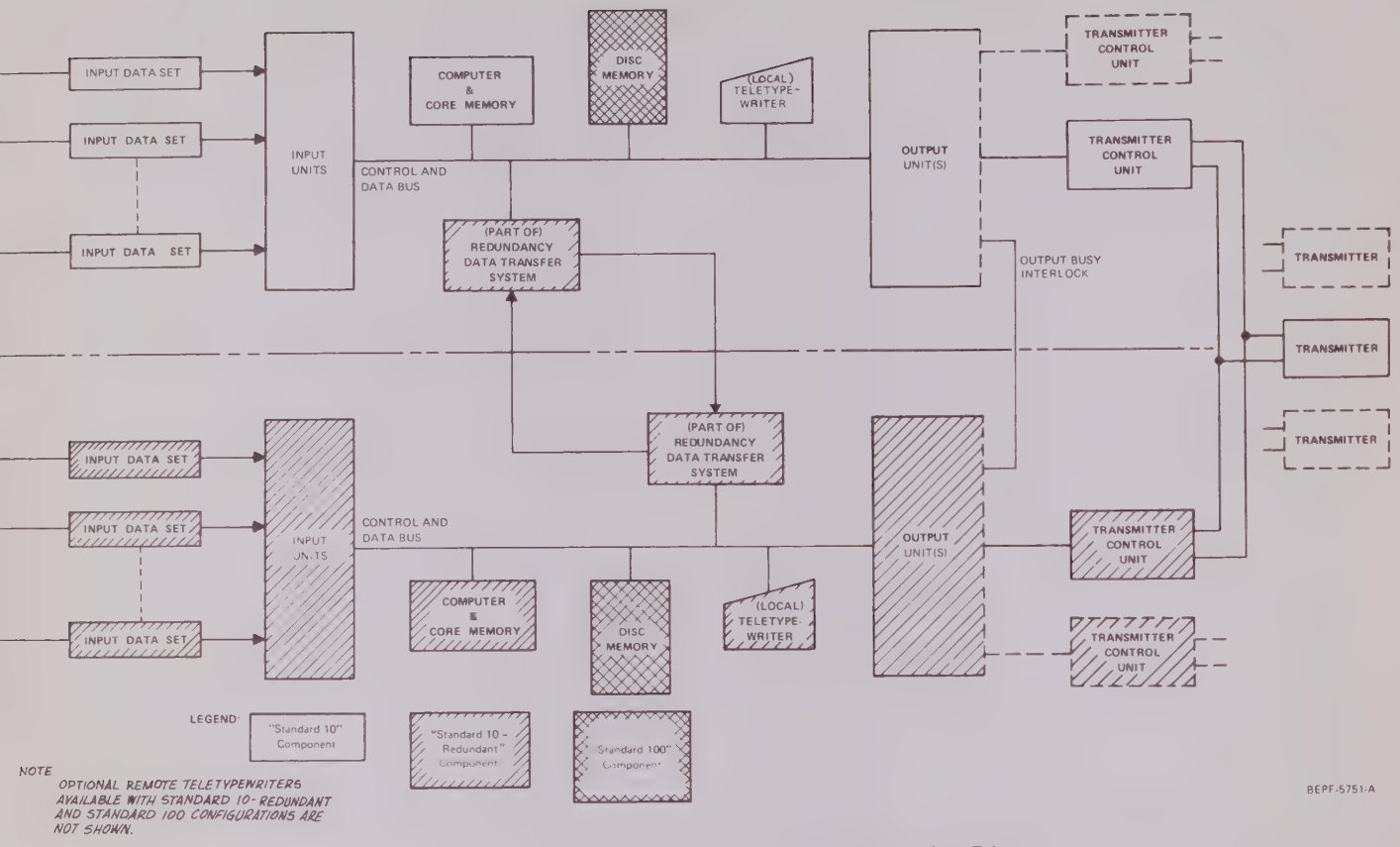


Figure 2-1. "Metro-Page" 10/100 System Expansion Diagram

as an upgrade of already supplied Standard 10 equipment. The basic factory-supplied Standard 10- Redundant Terminal includes (see Figure 2-1):

- All components of an additional Standard 10 terminal identical to the original terminal (so that the redundant configuration is composed of two terminal "halves")
- Redundancy Data Transfer System components installed in each terminal half (redundant configurations)
- An appropriate software package

2.4 "METRO-PAGE" STANDARD 100 TERMINALS

A "Metro-Page" Standard 100 terminal may be either factory supplied or field-configured as an upgrade of previously supplied Standard 10 or Standard 10-Redundant equipment.

Operationally, a Standard 100 terminal configuration is similar to the smaller Standard 10-Redundant system configurations; however, the presence of a dual disc memory in Standard 100 configurations provides maximum system flexibility and efficiency in handling the higher subscriber capacity plus special features available with the Standard 100 software.

The basic factory-supplied "Metro-Page" Standard 100 Terminal includes (see Figure 2-1):

- All components provided with the basic factory- supplied Standard 10-Redundant terminal
- Two "small" disc memories (one in each termnal half)
- A Standard 100 (STD1ØØ) software package

The Standard 100 Terminal configuration can be expanded to include:

- 160 redundant end-to-end or selector-level inputs per terminal half
- 5 output units (per terminal half)
- 24 transmitter control units per output unit

(Note that the "small" disc memories supplied with the basic Standard 100 configuration are ample to provide full 75,000 subscriber capacity; for the 100,000 subscriber capacity expansion, the "large" disc system is required.)

2.5 CALL PROCESSING

As an aid to understanding "Metro-Page" 10/100 paging system operation, the general sequence of events occurring in the placing of a paging call via any "Metro-Page" 10/100 Terminal is described as follows:

A call originates at a dial pulse or end-to-end telephone and comes through the telephone system central office to a dial input or end-to-end data set within the paging terminals. The input data set forwards appropriate digit information to the computer which looks at the digits dialed in and checks to make sure they are valid pager numbers. If the number dialed is valid, the terminal sends a "call accepted" (valid) tone or recorded announcement to the calling party; while if the number is invalid, the calling party will receive an invalid call tone or recorded announcement. The computer records the call, initiates disconnect of the calling party, and forwards the page via the correct paging transmitter(s) to the required pager (or pagers, if a group call number has been dialed).

2.6 EQUIPMENT SUMMARY

Table 2-2 summarizes and briefly describes the equipment used in "Metro-Page" 10/100 Paging Terminal configurations.

As previously noted, each supplied paging terminal will be configured from a basic foundation model (two of the same type — for redundant configurations); plus a particular set of the kits listed in the non-basic-foundation categories.

Table 2-2. "Metro-Page" 10/100 Equipment Description Summary

Category	Model/Kit		Component Item(s)			Purpose/Usage
	Field-Installed	Description	Qty	Type	Description	
Basic Foundation	E52MTT0115A	Basic Terminal Foundation--115 V, 60 Hz	1	NHN6207A	19 in. Cabinet 115 V, 50-60 Hz	Provides basic equipment, cables, and accessories required in "Metro-Page" 10/100 installations operating from 115 V, 60 Hz primary power.
			1	NKN6167A	Basic Alarm Panel Cable	
			1	NKN6170A	Power Control Cable	
			2	NKN6179A	TCU Patch Cord	
			2	NKN6180A	Data Set Patch Cord	
			1	NLN8321A	Basic Input Test Unit	
			1	NLN8324A	Tone Oscillator Board	
			1	NLN8329A	Master Terminal Block	
			3	NLN8337A	Data Set Hinged Panel	
			4	NLN8338A	Standard Hinged Panel	
			1	NLN8395A	AC Distribution Panel, 115 V, 50-60 Hz	
			1	NLN8352A	Alarm Board "C"	
			2	NLN8353A	Alarm Board "D"	
			1	NLN8354A	Alarm Panel	
			1	NLN8504A	TCU Extender Board	
			4	NLN8505A	Accessory Drawer Extender Board	
			1	NLN8506A	Spare Parts and Accessory Kit	
			1	NLN8557A	Vendor Manuals	
			1	NPN6051A	System Power Supply 115 V, 50-60 Hz	
			1	SP570472101	Decwriter II	
			1	NLN8554A	Dial Input Test Blank Panel	
			1	NLN8553A	End-to-End Test Blank Panel	
			3	NLN8339A	Large (Data Set) Filler Panel	
			1	SP570192101	DEC, PDP 11/05-SC Computer with 16k Memory, 115 V, 50-60 Hz	
			1	SP570192140	Stall Alarm Board	
			1	NHN6206A	Accessory Drawer	
			1	NPN6050A	Power Supply, Accessory Drawer, 115 V, 50-60 Hz	
			2	NLN8332A	Large (TCU) Filler Panel	
			1	SP570192141	Stall Alarm Cable	
	E52MTT0230A	Basic Terminal Foundation--230 V, 50 Hz	1	NHN6213A	19 in. Cabinet, 230 V, 50-60 Hz	Provides basic equipment cables, and accessories required in "Metro-Page" 10/100 installations operating from 230 V, 50 Hz primary power.
			1	NKN6167A	Basic Alarm Panel Cable	
			1	NKN6170A	Power Control Cable	
			2	NKN6179A	TCU Patch Cord	
			2	NKN6180A	Data Set Patch Cord	
			1	NLN8321A	Basic Input Test Unit	
			1	NLN8324A	Tone Oscillator Board	
			1	NLN8329A	Master Terminal Block	
			3	NLN8337A	Data Set Hinged Panel	
			4	NLN8338A	Standard Hinged Panel	
			1	NLN8560A	AC Distribution Panel, 230 V, 50-60 Hz	
			1	NLN8352A	Alarm Board "C"	
			2	NLN8353A	Alarm Board "D"	
			1	NLN8354A	Alarm Panel	
			1	NLN8504A	TCU Extender Board	
			4	NLN8505A	Accessory Drawer Extender Board	
			1	NLN8506A	Spare Parts and Accessory Kit	
			1	NLN8557A	Vendor Manuals	
			1	NPN6057A	System Power Supply, 230 V, 50-60 Hz	
			1	PLN6154A	DECwriter II	
			1	NLN8554A	Dial Input Test Blank Panel	
			1	NLN8553A	End-to-End Test Blank Panel	
			1	NLN8339A	Large (Data Set) Filler Panel	

Table 2-2. "Metro-Page" 10/100 Equipment Description Summary (Cont'd.)

Category	Model/Kit		Component Item(s)			Purpose/Usage
	Field-Installed	Description	Qty	Type	Description	
			1	SP570144102	DEC PDP 11/05-SD Computer with 16k Memory; 230 V, 50-60 Hz	
			1	SP570192140	Stall Alarm Panel	
			1	NHN6206A	Accessory Drawer	
			1	NPN6056A	Power Supply, Accessory Drawer, 230 V, 50-60 Hz	
			2	NLN8332A	Large (TCU) Filler Panel	
			1	SP570192141	Stall Alarm Cable	
Inputs	NLN1241A	End-to-End Line Interface Set	1	NLN8289A	Input Register Board	Provides the electronic interface between and end-to-end type input telephone line and a computer control and data bus. **NOTE** The end-to-end receiver plus logic board combination is generally referred to as an end-to-end data set.
			1	NLN8291A	End-to-End Line Receiver Board	
			1	NLN8283A	End-to-End Logic Board	
	NLN1238A	Dial Input Line Interface Set	1	NLN8289A	Input Register Board	Provides the electronic interface between a selector-level (dial-pulse) type input telephone line and a computer control and data bus. **NOTE** The dial input line receiver plus logic board combination is generally referred to as a dial-input data set.
			1	NLN8293ASP4	Dial Input Line Receiver Board	
			1	NLN8292A	Dial Input Logic Board	
	NLN1236ASP1	Mounting for Four Line Interface Sets	1	NKN6166A	Unibus Jumper Module	Provides mounting facilities and accessory items associated with up to eight line interface sets. **NOTE** The NLN8290A; NLN8266A; NLN8287A; and up to eight NLN8289A's (from line interface sets) are generally referred to as and "input unit".
			2	NLN8284A	Data Set Connector Board	
			1	NLN8285A	Data Set Mounting Rack	
			1	NLN8286A	Address Decoder Board	
			1	NLN8287A	Interrupt Control Board	
			1	NLN8290A	Input Connector Block	
			1	NLN8328A	Input Data Set Fuse Panel	
			1	NLN8355A	Expansion Fuse Kit	
			1	NKN6168A	Alarm Board "A" Cable	
			1	NLN8350A	Alarm Board "A"	
		Ringback Generator Board	1	NLN8320A	Ringback Generator Board	Provides the telephone-type ring-back signal required when dial-input line interface sets are used.
		End-to-End Input Test Unit	1	NLN8322A	End-to-End Input Test Unit	Together with the NLN8321A Basic Input Test Panel (of a basic terminal foundation kit), provides the capability of performing "system self-tests" associated with dial-input type input lines.
		Dial-Input Test Unit	1	NLN8323A	Dial-Input Test Unit	Together with the NLN8321A Basic Input Test Panel (of a basic terminal foundation kit), provides the capability of performing "system self-tests" associated with dial-input type input lines.
	NLN1237ASP1	Secondary Mounting for Four Data Sets	1	NLN8284A	Data Set Connector Board	
			1	NLN8355A	Expansion Fuse Kit	
Outputs	NLN1151A	Output Unit Alarm Expansion	1	NKN6196A	Alarm Cable	Necessary cabling and circuit board for each alarms unit.
			1	NLN8351A	Alarm Board "B"	
	SP57030611	Dual Function Decimal Digital (DFDD) Output Unit, Mounting, and TCU Rack	1	SP570306101	DFDD Output Register Board	Provides output unit, mounting facilities, and accessory items associated with a basic dual function decimal digital (DFDD) output unit implementation. Each DFDD Output unit contains logic circuitry and storage registers that form the interface between computer and up to 24 DC or tone transmitter control units (TCU's) for the purpose of encoding DFDD: standard two-tone (optional); or subaudible two-tone (optional); or subaudible two-tone (optional)--type paging signals.
			1	SP570306102	DFDD Output Control Board	
			1	SP570306103	DFDD Coder Board	
			1	SP570306104	DFDD Output Connector Block	
			1	NLN8314A	Address Selector Board	
			1	NLN8287A	Interrupt Control Board	
			1	NLN8301A	Filter Board #1	
			1	NLN8303A	Synthesizer Board	
			1	NLN8296A	TCU Interface Board	
			1	NKN6171A	DFDD Output Cable	
			1	NKN6166A	Unibus Jumper Module	
	NLN1136A	Two-Tone Coding for DFDD Output Unit	1	NLN8299A	Two-Tone Coder Board	Adds two-tone coding capability to the NLN1322A Kit.
			1	NLN8300A	Filter Board #2	
		Subaudible Coding for DFDD Output Unit	1	NLN8302A	Subaudible Board	Adds subaudible coding capability to the SP57030611 Kit equipped with the NLN1136A Kit.
		DC Transmitter Control Unit (DC TCU)	1	NLN8334ASP3	DC Transmitter Control Unit (DC TCU)	Provides a DC-type control interface between a DFDD output unit and a remotely located paging transmitter.
	NLN1142ASP1	Tone Transmitter Control Unit (Tone TCU)	1	NLN8333ASP3	Tone Transmitter Control Unit (Tone TCU) less Vibrasender & Vibrasponder	Provides an audio-tone-type control interface between a DFDD output unit and a remotely located paging transmitter.
			1	TLN6824	Vibrasender for Tone TCU	
			1	TLN6709	Vibrasponder for Tone TCU	
		Binary Transmitter Control Unit (TCU)	1	NLN8748A	Binary Transmitter Control Unit (Binary TCU)	Provides an audio-tone-type control interface between a binary output unit and a remotely located paging transmitter.
	NLN1248A	Binary Output Unit and Mounting	1	NKN6210A	Cable	Provides mounting hardware for two binary output units and provides the first binary output unit.
			1	NLN8883A	Binary Board	
			1	NLN8287A	Interrupt Control Board	
			1	NLN8314A	Address Select Board	
			1	NLN8884A	Mounting Block	

Table 2-2. "Metro-Page" 10/100 Equipment Description Summary (Cont'd.)

Category	Model/Kit		Component Item(s)			Purpose/Usage
	Field-Installed	Description	Qty	Type	Description	
	NLN1249A	Binary Output Unit	1	NLN6210A	Cable	Provides second binary output unit for mounting in an existing output block.
			1	NLN8883A	Binary Output Board	
	NLN1121A	TCU Rack and Terminator, Primary	1	NLN8335A	TCU Card Rack	Primary TCU rack provides mounting for first eight TCU's associated with each output unit.
			1	NLN8356A	TCU Terminator Board	
			8	NLN8556A	Single TCU Filler Panel	
	NLN1143A	Expansion Rack for Eight TCU's	1	NKN6173A	TCU Expansion Cable	Provides the capability for accommodating an additional eight transmitter control units.
			1	NLN8507A	TCU Expansion Card Rack	
			7	NLN8556A	Single TCU Filler Panel	
	SP57021201	Modem for Binary Transmitter (Universal Data System Modem)	—	—	—	An accessory available at a transmitter site for interfacing binary tone signals (from a binary TCU) with the paging transmitter.
Memory		Core Memory Expansion to 28k	1	SP570192201	16k Core Memory (DEC MF11-U)	Increases the core memory capacity of a PDP 11/05 computer -- to 28k words.
	NLN1230A	Dual Small Disc System and Cabinet, 115 V, 50-60 Hz	2	NHN6207A	19 in. Cabinet, 115 V, 50-60 Hz	Accessory available for use in "Metro-Page" Standard 100 (115 V) configurations.
			2	NKN6181A	Unibus Connector Cable, 15 ft.	
			6	NLN8332A	Filler Panel	
			8	NLN8338A	Standard Hinged Panel	
			6	NLN8339A	Data Set Filler Panel	
			2	NLN8694A	Small Disc System, 115 V, 50-60 Hz	
			2	NLN8697A	Disc Front Panel	
			2	NLN8698A	AC Junction Box	
			2	NLN8569A	Dress Strip	
			12	NLN8337A	Data Set Hinged Panel	
	NLN1231A	Dual Large Disc System and Cabinet, 115 V, 50-60 Hz	2	NHN6207A	19 in. Cabinet, 115 V, 50-60 Hz	Accessory available for use in "Metro-Page" Standard 100 (115 V) configurations.
			2	NKN6181A	Unibus Connector Cable, 15 ft.	
			6	NLN8332A	Filler Panel	
			8	NLN8338A	Standard Hinged Panel	
			6	NLN8339A	Data Set Filler Panel	
			2	NLN8695A	Large Disc System, 115V, 50-60 Hz	
			2	NLN8697A	Disc Front Panel	
			2	NLN8698A	AC Junction Box	
			2	NLN8596A	Dress Strip	
			12	NLN8337A	Data Set Hinged Panel	
	NLN1231ASP1	Dual Large Disc System and Cabinet, 230 V, 50-60 Hz	2	NHN6207ASP2	19 in. Cabinet with Fan, 230 V, 50-60 Hz	Accessory available for use in "Metro-Page" Standard 100 (230 V) configurations.
			2	NKN6181A	Unibus Connector Cable, 15 ft.	
			6	NLN8332A	Filler Panel	
			8	NLN8338A	Standard Hinged Panel	
			2	NLN8695A	Large Disc System 115 V, 50-60 Hz	
			2	NLN8697A	Disc Front Panel	
			4	NLN8569A	Dress Strip	
			12	NLN8337A	Data Set Hinged Panel	
			2	SP570144112	Transformer, 230/115 V AC Stepdown	
			2	SP57014412	AC Junction Box	
Recorders and Valid/Invalid Annunciators	NLN1137A	Valid or Invalid Voice Recorder System, 115 V, 60 Hz	1	NKN6176A	Recorder Audio Cable	Accessory available for use in any "Metro-Page" 10/100 (115 V) configuration to provide a recorded invalid call message.
			1	NLN8325A	Recorder Control Board	
			1	NLN8348A	Announcement Recorder, 115 V, 60 Hz	
			1	NKN6185A	Cable, Valid Call	
	NLN1107A	ASI Recorder	1	NKN6176A	Recorder Audio Cable	Accessory for DFDD "Metro-Page" 10/100 (115 V) configurations which provides automatic voice station identification capability.
			1	NKN6187A	ASI Expansion Cable	
			1	NLN8326A	ASI Control	
			1	NLN8348A	Announcement Recorder, 115 V, 60 Hz	
High Speed Tape		High Speed Paper Tape Reader/Punch 115 V, 60 Hz	1	NLN8889A	High Speed Paper Tape Reader/Punch 115 V, 60 Hz	Accessory for "Metro-Page" 10/100 (115 V) configurations.
		High Speed Paper Tape Reader/Punch, 230 V, 50 Hz	1	NLN8889ASP3	High Speed Paper Tape Reader/Punch, 230 V, 50 Hz	Accessory for "Metro-Page" 10/100 (230 V) configurations.
	PLN1010A	Dual Magnetic Tape System, 115 V, 60 Hz	2	PLN6129A	Magnetic Tape Drive and Interface 115 V AC	Accessory for "Metro-Page" Standard 100 (115 V) configurations.
			2	PLN6130A	Bootstrap ROM Board	
	PLN1011A	Dual Magnetic Tape System, 230 V 50 Hz	2	PLN6131A	Magnetic Tape Drive and Interface 230 V	Accessory for "Metro-Page" Standard 100 (230 V) configurations.
			2	PLN6130A	Bootstrap ROM Board	
Special Power	NLN8767A	Control Switch	+	+	+	Accessory for "Metro-Page" 10/100 configurations requiring an external -48 V/-125 V power source.
	NPN1017A	-48V Power Supply 115 V, 60 Hz	1	NKN6177A	48V Distribution Cable	Accessory for "Metro-Page" 10/100 configurations using dial-input data sets and/or DC TCU's
			1	NPN6054A	48 V Power Supply	
	NPN1016A	-130 V Power Supply, 50-60 Hz	1	NKN6186A	130 V Distribution Cable	Accessory for "Metro-Page" 10/100 configurations using DC TCU's
			1	NPN6060A	130 V Power Supply	
System Growth	NLN1150A	Auxiliary Terminal Block (ATB) and Cable	1	NLN8568A	Auxiliary Terminal Block	Provides capability of increasing system capacity by 16 input data sets; one output unit; and eight TCU's
			2	NKN6178A	Expansion Cable	
	SP57077611	System Power Supply Expansion, 115 V, 50-60 Hz	1	NPN6051A	System Power Supply 115 V, 50-60 Hz	Provides capability of increasing system +5 V and +12 V power capacity for "Metro- Page" 10/100 (115 V) configurations.
			1	NKN6170A	Power Distribution Cable	
			1	NLN8352A	Alarm Board "C"	
			1	SP570192151	Alarm Board "C" Cable	

Table 2-2. "Metro-Page" 10/100 Equipment Description Summary (Cont'd.)

Category	Model/Kit		Component Item(s)			Purpose/Usage
	Field-Installed	Description	Qty	Type	Description	
	PLN1012A	System Power Supply Expansion, 230 V 50-60 Hz	1	NPN6057A	System Power Supply, 230 V, 50-60 Hz	Provides capability of increasing system +5 V and +12 V power capacity for "Metro-Page" 10/100 (230 V) configurations.
			1	NKN6170A	Power Distribution Cable	
			1	NLN8352A	Alarm Board "C"	
			1	SP570192151	Alarm Board "C" Cable	
System Growth	SP57006017	Unibus Repeater (DEC DB11-A)	+	+	+	Provides buffering for driving additional peripheral devices connected to a computer Unibus.
	NLN1120A	Accessory Drawer Expansion, 115 V, 50-60 Hz	1	NHN6206A	Accessory Drawer	Provides capacity for additional Unibus peripheral devices (115 V terminal configurations).
			1	NPN6050A	Power Supply	
	NHN6212ASP1	Accessory Drawer Expansion, 230 V, 50-60 Hz	1	NHN6212A	Accessory Drawer	Provides capacity for additional Unibus peripheral devices (230 V terminal configurations).
			1	NPN6056A	Power Supply	
		AC Distribution Panel, 115 V, 50-60 Hz	1	NLN8395A	AC Distribution Panel, 115 V, 50-60 Hz	Provides a 30A interface to primary 115 V AC power.
	SP57091411	Alarm Panel Expansion and Cable	1	SP570914110	Alarm Panel Expansion	Provides the capability of expanding initial alarm-monitoring capability to accommodate alarms associated with: • 96 additional data sets • one additional output unit • three additional system power supplies
			1	NKN6178A	Expansion Cable	
Redundancy	NLN1256A	Redundancy Data Transfer System	1	NLN8699A	Data Transfer Module (DEC DR11-C)	Provides a buffered communication link between the two computers of a "Metro-Page" 10/100 redundant terminal configuration (i.e. between the computer in each redundant half).
			1	NKN6193A	Data Transfer Module Cable	
	NLN1252A	Redundant Switchboard and Cable	1	NLN8700A	Redundant Switchboard	Provides inter-terminal half switching functions associated with a "Metro-Page" 10/100 redundant terminal configuration.
			1	NKN6195A	Redundant Switchboard Cables	
		TCU Impedance Matching Board	1	NLN8876A	TCU Impedance Matching Board	For "Metro-Page" 10/100 redundant terminal configurations, insures correct loading on TCU output lines upon a terminal half failure.
		Redundant Switchboard Mounting Panel	1	NLN8701A	Redundant Switchboard Mounting Panel	Accommodates redundant switchboards and TCU impedance matching boards (up to eight mounting slots, per panel).
Delay Equalizing	NLN1261A	Delay Equalizer Block and Mounting Chassis	1	NLN6529A	Delay Equalizer Block	Accessory available for use in any "Metro-Page" 10/100 terminal to insert signal delay in the telephone line between the paging terminal and a particular paging transmitter site. (Separate blocks are used in the line to each transmitter site and are adjusted to equalize the phase of all transmitted signals arriving in a particular common coverage area.) Up to four blocks are accommodated.
			1	NLN8945A	Delay Equalizer Mounting Chassis	
	SP57057811	Stop/Detect Module	6	NLN8700A	Redundant Switchboard	
			1	NLN8701A	Panel, Redundant Switchboard and Cable	
			1	SP570578111	Modified Terminal Down Alarm	
			1	SP570578112	Modified Terminal Down Alarm Receiver	
	NLN1139A	Lockout Kit	1	NLN8545A	Lockout Board	Accessory available for use in any "Metro-Page" 10/100 terminal to allow the paging system to time-share rf transmitter facilities with other services.
			1	NKN6188A	Lockout Cable Connector	
			1	NKN6182A	Lockout Cable	
Remote Teletype Writers			1	NLN8739A	Remote Teletypewriter and Modem, 115 V, 60 Hz	Accessory available for use with "Metro-Page" (115 V) Standard 10- redundant or Standard 100 configurations to transfer/receive remote user data via FSK tones.
			1	NLN8739ASP3	Remote Teletypewriter and Modem, 230 V, 50 Hz	Same as the NLN8739A, but for 230 V configurations.
			1	NLN8740A	Modem Remote Teletypewriter (Terminal End)	Accessory available for use in "Metro-Page" 10/100 terminals to interface the paging terminal with the remote (user) teletypewriters via FSK tones.
			1	NLN8307A	DC Remote Teletypewriter 115 V, 60 Hz	Accessory available for use with "Metro-Page" 10/100 (115 V) configurations to transfer/receive software data via a 4-wire full duplex arrangement (one 20 mA current loop for each signalling direction)
			1	NLN8500A	DC Remote Teletypewriter, 230 V, 50 Hz	Same as the NLN8307A, but for 230 V configurations.
			1	NLN8744A	DC Remote Teletypewriter, Line Interface	Provides second Interface for DC Remote TTY, mounts in NLN8743A
			1	NLN8743A	Mounting for Two Remote Teletypewriter Line Interfaces and first DC Interface.	Accessory which, together with a set of remote teletypewriter interface modules (such as NLN8741A), provides a paging-terminal interface for a remote teletypewriter.

Table 2-2. "Metro-Page" 10/100 Equipment Description Summary (Cont'd.)

Category	Model/Kit		Component Item(s)			Purpose/Usage
	Field-Installed	Description	Qty	Type	Description	
			1	SP570472102	Remote Decwriter II with Modem 115 V, 50-60 Hz	
			1	NLN8741A	RS-232-C Remote Interface, provides mounting hardware for two and the first Interface	
			1	NLN8742A	RS-232-C Remote Interface, provides the second Interface for NLN8741A.	
Cabinets	NHN1001A	Expansion Cabinet, 115 V 50-60 Hz	1 8 2 1	NHN6207A NLN8332A NLN8349A NLN8569A	19 in. Cabinet Filler Panels Blank Drawer Dress Strip	Accessory available for "Metro-Page" 10/100 (115 V) Configurations.
			1	NHN6213A	Expansion Cabinet (19 in.) 230 V, 50-60 Hz	Accessory available for "Metro-Page" 10/100 (230 V) configurations.
Software		"Metro-Page" RDUN10/RBIN10 Software Package	+	+	+	The set of software tapes supplied with a "Metro- Page" Standard 10- Redundant configuration. **NOTE** Single terminal as well as two-terminal-half Standard 10-Redundant configurations are available.
		"Metro-Page" STD100 software package	+	+	+	The set of software tapes supplied with a "Metro- Page" Standard 100 configuration.
			1	SP570192102	PDP 11/05 Computer Spare Boards (115 V AC)	One each of the common Computer spare boards.
			1	SP570144104	PDP 11/05 Computer Spare Boards (230 V AC)	One each of the common computer spare boards.
	NLN1243A	Binary/Terminal Spare Boards	1 1 1 1 1 1 1 1 1 1 1 1	NLN1168A NLN8286A NLN8287A NLN8289A NLN8314A NLN8324A NLN8325A NLN8350A NLN8351A NLN8352A NLN8353A NLN8356A	Binary Output Board Address Decoder Board Interrupt Control Board Input Register Board Address Select Board Tone Oscillator Board Recorder Control Board Alarm Board "A" Alarm Board "B" Alarm Board "C" Alarm Board "D" TCU Terminator Board	
	SP57030612	DFDD Spare Boards	1 1 1	SP570306101 SP570306102 SP570306103	Output Register Board Output Control Board 6 Tone Coder Board	
	NLN1145ASP3	DFDD/Terminal Spare Boards	1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1	SP570306101 SP570306102 SP570306103 NLN8303A NLN8286A NLN8287A NLN8289A NLN8296A NLN8301A NLN8314A NLN8324A NLN8325A NLN8326A NLN8350A NLN8351A NLN8352A NLN8353A NLN8356A	Output Register Board Output Control Board 6 Tone Coder Board Synthesizer Board Address Decoder Board Interrupt Control Board Input Register Board TCU Interface Board Filter Board #1 Address Select Board Tone Oscillator Board Recorder Control Board Automatic Station I.D. Board Alarm Board "A" Alarm Board "B" Alarm Board "C" Alarm Board "D" TCU Terminator Board	
			1	NLN8506A	Spare Parts and Accessories	Includes Fuses, Fuse Alarms, Lamps, IC Test Clips, a Handset, Wire Wrapping and Unwrapping Tools, Recording Tape, and General Hardware Items.

3. SITE PREPARATION/ UNPACKING/INSTALLATION

3.1 INTRODUCTION

The following paragraphs describe the procedures to be followed in installing "Metro-Page" 10/100 Paging Terminal equipment. Some paragraphs relate to specific equipment that may or may not be included in your paging system. These paragraphs will be qualified within the heading of the paragraph and may be skipped if they do not apply to your equipment.

3.2 CHOOSING TERMINAL LOCATION**

Choose a location for the main paging terminal equipment which is compatible with the physical and electrical requirements of the terminal as listed in the terminal's technical specifications. As a general rule, the terminal should be installed in an air conditioned environment as temperature and humidity are maintained at a constant level. The terminal is designed to operate in a temperature range of 55 degrees F to 100 degrees F and a non-condensing humidity range of 20 percent to 80 percent. The air conditioning should be capable of dissipating the heat generated by the equipment which is in the range of 150k BTU's to 180k BTU's per equipment rack.

NOTE

**For Pre-op testing, it is advised that all remote terminals and remote modems be located at Metro terminal until pre-op testing is complete.

Also, consider the following in selecting the terminal site:

- Do not install the terminal in a vibration/shock environment (e.g., in rooms adjoining machine shops, printing presses, refrigeration equipment, etc.).

- Avoid, if possible, installing the terminal in extremely dusty areas. (The equipment contains normally adequate filtering, but in an extremely dusty environment, internal ventilation may become insufficient unless filters are used and are frequently cleaned.)

- As with any complex electronic facility, the performance of this paging terminal may be degraded by spurious signals received from outside sources. This type of interference can be minimized by selecting the terminal location well away from generators of electrical noise such as large motors, switchgear, welding equipment, etc.; and by insuring that the power input circuits to the terminal are of adequate power rating and are unshared by other equipment.

- The computer equipment, although immune to most low-level interference, is particularly susceptible to discharges of static electricity. These discharges, which often reach high potentials, can introduce errors in data or instructions and may cause erratic operation or a computer "halt." Non-conductive household carpeting provides an excellent medium for the generation of static potentials and this floor covering is NOT recommended for use at the terminal. It is recommended that conductive carpeting or tile, manufactured especially for computer installations, be used in the terminal room. Conductive carpeting is available from Digital Equipment Corporation.

If a conductive floor covering is not used, the area around the terminal must be sprayed with anti-static compound at least once a week during periods of low humidity. A suitable chemical is supplied in spray cans under the brand name Static-Stop, manufactured by Barco Chemical Products, Chicago, Il. Other equivalent products are available and these should serve as well. However, be sure that the product selected will not damage the floor covering or the Plexiglass panels on the terminal.

- This equipment requires periodic maintenance. Therefore, it should have a minimum of three feet of clearance in the front and back to provide optimum access for the service personnel.

3.3 UNPACKING AND INSPECTION

Move all shipping crates containing paging terminal equipment to the location chosen for installation.

Unpack the shipping crates containing the main paging terminal cabinets. Open access panels or doors and remove tape, supports, shims, etc. Remove all cables and line cords packed loose inside the cabinet. Unpack all teletypewriters. Refer to the LA36/LA35 DECwriter II Users Manual for comprehensive unpacking instructions.

If the equipment is supplied with a paper tape reader/punch unit, a shipping screw that secures the unit must be removed. This screw secures the unit to the stationary rear support of the slide supports.

Thoroughly inspect the interior and exterior of the equipment and cabinets. Check especially for loose connections, foreign objects, and bent or broken pins on the terminal blocks mounted at the rear of the cabinets.

If major shipping damage is discovered, file a claim immediately with the transportation company and contact Motorola Portable Products Division in Fort Lauderdale, FL, to obtain advice concerning the disposition of the equipment.

3.4 DISC MEMORY INSTALLATION (STANDARD 100 CONFIGURATIONS ONLY)

CAUTION

This unit may have "TRIP-N-TELL" and/or shock indicators installed. They are used to detect the possible mishandling of the equipment that could result in damage or malfunction.

If your unit has either indicator installed, inspect for tripping. If tripped, take the following action:

- "TRIP-N-TELL" and/or 10 G sensor tripped, but the 20 G sensor intact, indicates that possible shipping damage may have occured. Thoroughly inspect for shipping damage. If any damage is found, notify the carrier and DDC's Field Service, as shipping damage will void DDC's warranty. The warranty will only be reinstated after an authorized DDC Field Service representative has inspected and tested the unit.

- 20G shock indicator tripped, indicates that probable shipping damage has occured. Notify the carrier and DDC Field Service. DO NOT APPLY POWER!

Referring to Figure 3-1, install each disc- accommodating bay using the following instructions. (The parenthetical numbers in the instruction steps refer to the callout numbers used in this drawing.)

NOTE

The disc-accommodating bay is normally shipped with the disc controller, the disc power supply, and most of the hardware items--premounted at the positions indicated within the assembly diagram; while the disc (already attached to the base plate) is shipped within a separate shipping crate.

Step 1. Open the shipping crate containing the disc and the base plate, then remove the two screws holding each corner of the plate to the crate.

Step 2. Remove the disc (14) and base plate (13) from the shipping crate and install into the disc- accommodating cabinet by inserting the tabs secured to the bottom metal runners attached to the base plate (13) into the slots provided on the disc support slides (9).

Step 3. Plug the ac line cord from the power supply (1) into one of the ac receptacles on the ac junction box (24).

Step 4. Plug the dc output cable connector into the mating connector on the left side (when viewed from the rear) of the power supply (1). Plug the other end of this cable into mating connector J2 at the rear of the disc memory unit (14).

Step 5. Plug the ac line cord from the controller (5) into one of the ac receptacles on the ac junction box (24).

Step 6. Interconnect the controller (5) to the disc memory unit (14) by plugging the multiple-conductor flat cable (gray) into mating connector J10 at the rear of the disc memory unit (14).

Step 7. Plug the ac line cord from the disc memory unit (14) into an unswitched ac receptacle, to provide uninterrupted ac power.

Step 8. Plug the ac junction box line cord into one of the ac distribution panel receptacles of the paging terminal half.

3.5 MAIN PAGING TERMINAL CABINET PREPARATION

Each bay (cabinet) of the main paging terminal has been labelled with a number at the factory. Arrange the main paging terminal cabinets in ascending order with bay 1 in the leftmost location and the highest numbered bay in the rightmost location — as viewed from the front of the equipment.

3.6 MAIN PAGING TERMINAL INTERCABLING

3.6.1 General

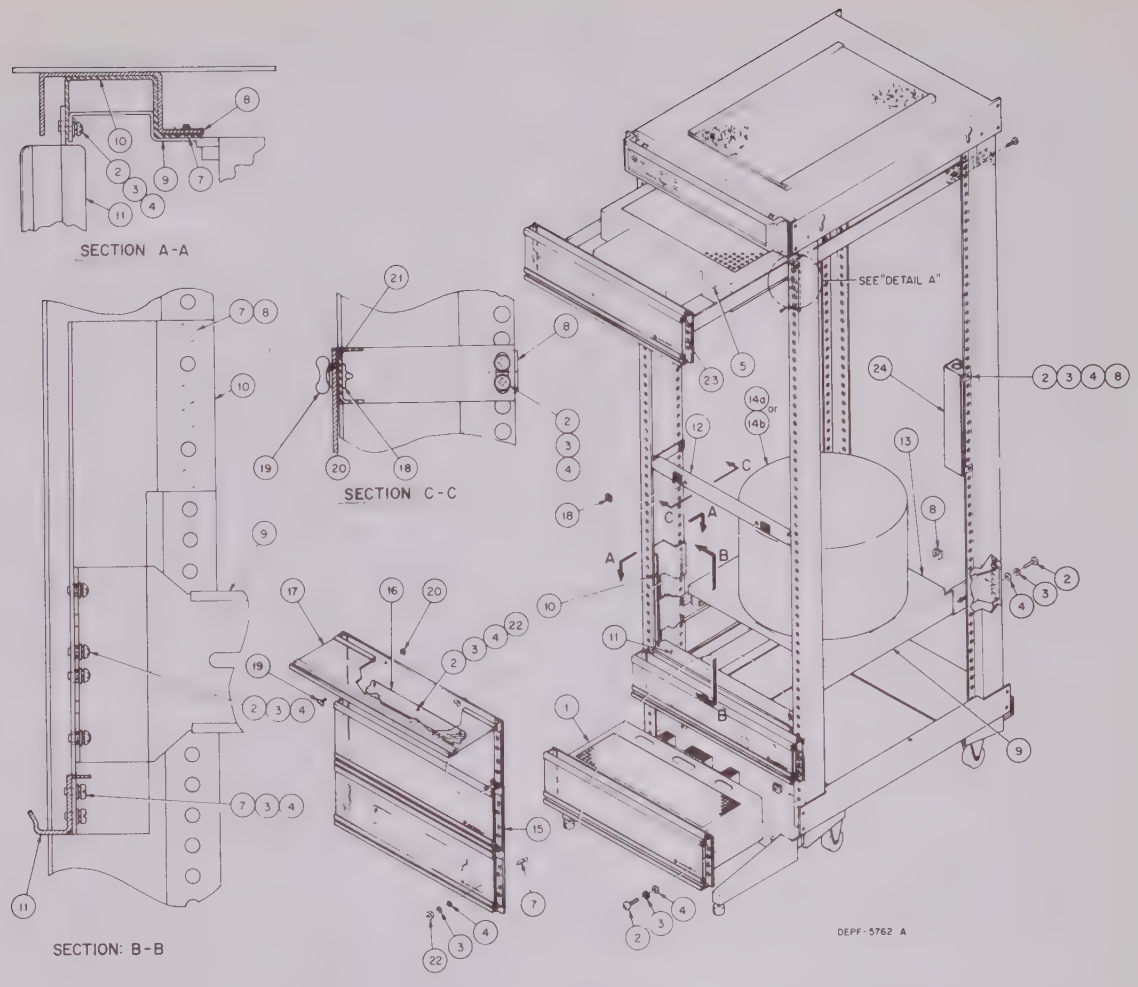
Interconnections between the various subcomponents of the main paging terminal are summarized in the "Metro-Page" 10/100 Intercabling Diagram, Figure 3-2. This diagram should be used in conjunction with the specific intercabling instruction described in the following paragraphs.

When shipped, terminal equipment racks are separated necessitating the removal of inter-rack cables. For ease of installation, only inter-rack cables have been disconnected.

As a general rule, these cables are only disconnected at the expansion rack end. They are labeled and stored in the rack that houses the computer. For multi-rack configurations, the inter-rack cables are removed from the rack that is physically the most distant from the rack that houses the computer. The cables are labeled and stored in the adjacent rack.

In general, the cables that need to be reconnected are labeled and are as follows:

- Inter-rack power cables, from ac junction box to where labeled on connector.
- Unibus (flat ribbon cable) in and out if required.
- First TCU rack (in expansion rack) to terminal block MTB1, J8, and J9.
- Terminal block ATB1, J18 and J19 to MTB1, J5 and J6.



LEGEND

ITEM	DESCRIPTION
1	POWER SUPPLY
2	SCREW, PHILLIPS HD
3	LOCKWASHER, #10
4	WASHER, FLAT
5	CONTROLLER (DDC MODEL DMS-11)
6	SUPPORT, BAR
7	SCREW, MACHINE, 10-32X3/8
8	NUT, CLIP-ON
9	SLIDES, DISC SUPPORT (PAIR)
10	BRACKET, SUPPORT (LEFT SIDE)
11	BRACKET, SUPPORT BAR (BOTTOM)
12	BRACKET, SUPPORT BAR (TOP)
13	PLATE, BASE
14a	DISC MEMORY UNIT (SMALL)
14b	DISC MEMORY UNIT (LARGE)
15	PANEL, FRONT, 21-INCH
16	HANDLE, PANEL
17	WINDOW, PLEXIGLASS
18	NUT, SPRING
19	FASTENER, WING
20	WASHER
21	SPRING, EJECTOR
22	NUT, 10-32 X 5/16
23	CLIP, WINDOW
24	JUNCTION BOX, AC

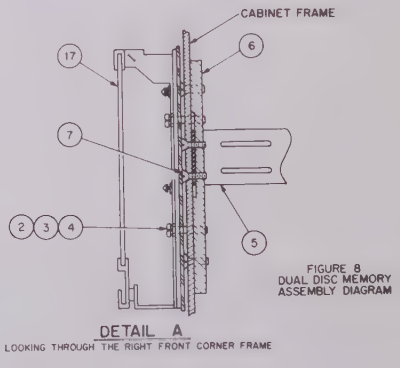


FIGURE 8
DUAL DISC MEMORY
ASSEMBLY DIAGRAM

Figure 3-1. Disc Memory Assembly Diagram

- Data sets in expansion rack #1 must be connected to the appropriate connector in the accessory drawer in the rack that houses the computer. Note, these cables are stored in the rack that houses the data sets. Each data set has a connector that terminates in the accesory drawer. Each connector is labeled.
- Alarm cord connectors terminate at specific terminal blocks (ATB/MTB). Each cable will be labeled.
- The teletype power cable plugs into the ac junction box at the computer equipment rack. See paragraph 3.6.3 for additional connector.
- Braided ground straps.

3.6.2 MTB/ATB Cabling

Each cable equipped with a 44-pin printed circuit connector card connects to an appropriate connector of a master terminal block (MTB) or an auxiliary terminal block (ATB). Each connector card is marked to indicate MTB/ATB destination. For example, the connector card labeled "MTB-3" inserts into connector J3 of the MTB; the card labeled "ATB 2-7" inserts into connector J7 of ATB-2; etc. (In each terminal half, MTB, ATB-1, ATB-2, etc. are designated by labels.)

Reconnect all MTB/ATB cables which were disconnected prior to shipping.

3.6.3 Local Teletypewriter Cabling

Connect each terminal half's local teletypewriter (via the teletypewriter's permanently attached cable) as follows:

Step 1. Locate the gray round cable with the "Mate-N-Lok" connector which protrudes several feet from the rear of each terminal half's CPU drawer. This cable, which connects to the M9970 Teletypewriter Interface Board within the CPU drawer, provides the connection point for attaching a local teletypewriter.

Step 2. Plug the "Mate-N-Lok" connector at the end of the teletype teletypewriter cable into the "Mate-N-Lok" connector located in Step 1 above.

3.6.4 Inter-Peripheral Cabling

Insure that all computer peripheral devices are correctly inter-linked with Unibus* cables as shown/described in Figure 3-2 intercabling diagram. Note that Unibus connections within a computer/accessory drawer are made to UNIBUS IN/UNIBUS OUT slots of system unit peripherals; while Unibus connections to a disc system are to the disc controller.

3.6.5 Redundancy Related Intercabling (Redundant Configurations Only)

Step 1. Install the two, type NKN6193A, cables between the DR11-C Data Transfer Module in each terminal half. The opposite end of the cable inserted into connector 1 of the DR11-C card in terminal half A must be inserted into connector 2 on the DR11-C card of terminal half B; the opposite end of the cable inserted into connector 2 on the DR11-C card of terminal half A must be inserted into connector 1 on the DR11-C card of terminal half B. (See the DEC DR11-C manual for connector locations).

Step 2. Perform output-busy intercabling by wirewrapping a single #24 AWG solid conductor wire from MTB connector J10, pin P of one terminal half (via normally-open-upon-alarm contacts of the redundant switchboards in both terminal halves) to the same MTB connector and pin of the opposite terminal half. (See Figures 3-2, 3-3, and 3-4.)

NOTE

The output busy signals from all (same-rf-channel-utilizing) output units of a given terminal half are paralleled via MTB/ATB wiring to MTB connector J10, pin P of that terminal half; MTB connector J10, pin P also serves as the output busy connection point for the basic output unit of that terminal half.

Refer to the maintenance section (section 7) for a discussion of techniques and procedures applicable to making effective wire-wrap connections.

* Registered trademark of Digital Equipment Corp.

3.6.6 Inter-Cabinet/Local Teletypewriter Grounding

Electrically interconnect all cabinets with a braided ground strap bolted to the mounting flanges in the rear. Scrape away the paint and use a "star" washer or other device to make good contact with the metal when the bolt is tightened. Similarly, run a braided ground strap from each local teletypewriter to its associated cabinet ground point.

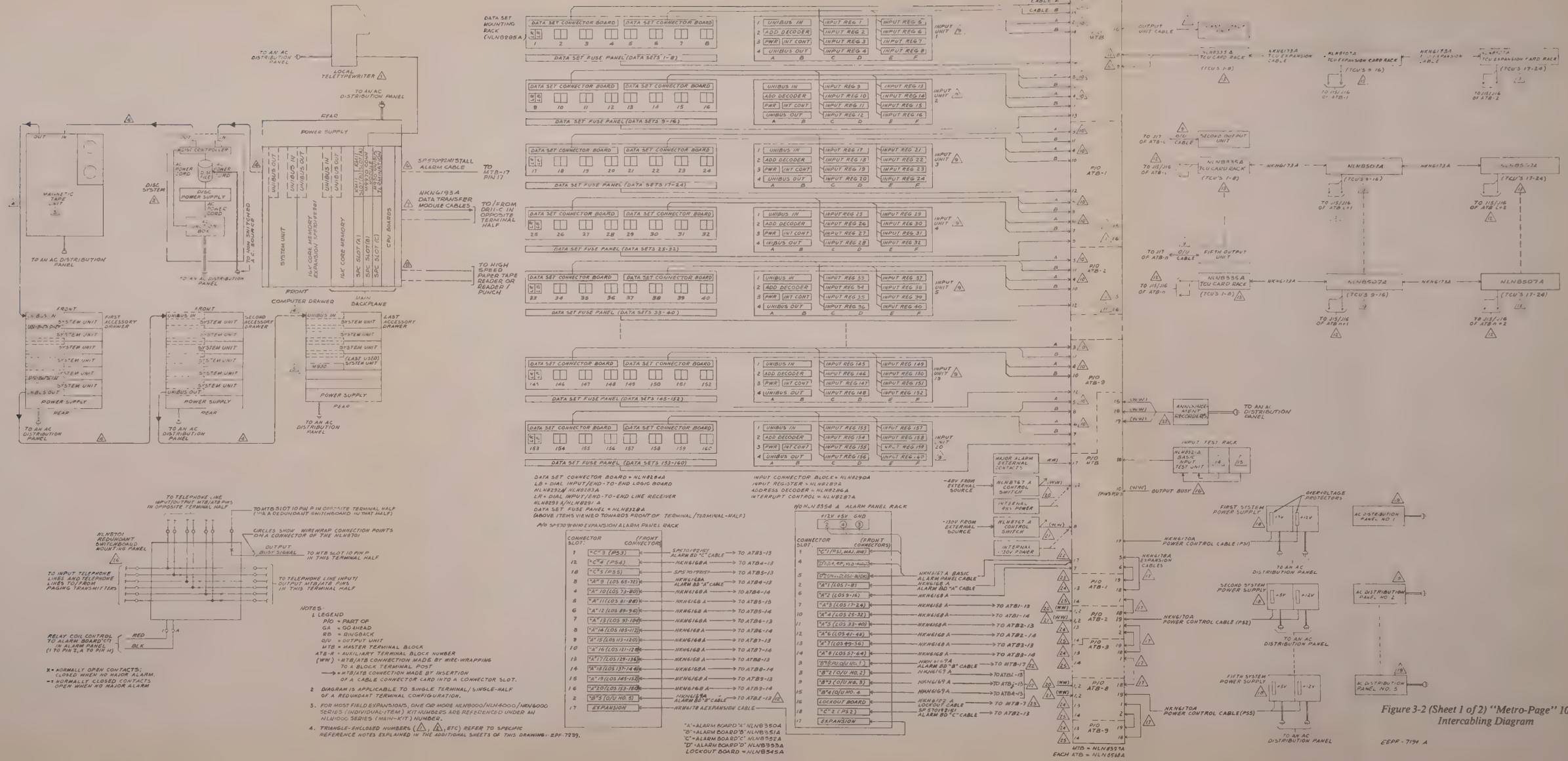
3.6.7 Cable Lacing

After all intercabling within each terminal half and between terminal half A and terminal half B is complete, lace all loose cables and wiring harnesses to the cable bars situated on the terminal blocks and in the cabinet.

3.7 POWER REQUIREMENTS/CONNECTIONS

3.7.1 Requirements

A minimum redundent system should have four separate power branches, one for each equipment rack. The disk drive requires a separate 20 amp service line. Each ac distribution box requires it's own 30 amp service line. As a general rule, one service distribution box is required for each 64 inputs. Permanent installations should be wired direct rather than using twist lock connectors. If the station battery (48 V) is used, which provides uninterruptable power, filter the supply at the terminal.


DATA SET MOUNTING RACK (NLN8885A)
DATA SET CONNECTOR BOARD
DATA SET FUSE PANEL (DATA SETS 1-8)
DATA SET FUSE PANEL (DATA SETS 9-16)
DATA SET FUSE PANEL (DATA SETS 17-24)
DATA SET FUSE PANEL (DATA SETS 25-32)
DATA SET FUSE PANEL (DATA SETS 33-40)
DATA SET FUSE PANEL (DATA SETS 145-152)
DATA SET FUSE PANEL (DATA SETS 153-160)
UNIBUS IN
ADD DECODER
PWR INT CONT
UNIBUS OUT
INPUT UNIT 1
INPUT UNIT 2
INPUT UNIT 3
INPUT UNIT 4
INPUT UNIT 5
INPUT UNIT 13
INPUT UNIT 20
INPUT REG 1
INPUT REG 2
INPUT REG 3
INPUT REG 4
INPUT REG 5
INPUT REG 6
INPUT REG 7
INPUT REG 8
INPUT REG 9
INPUT REG 10
INPUT REG 11
INPUT REG 12
INPUT REG 13
INPUT REG 14
INPUT REG 15
INPUT REG 16
INPUT REG 17
INPUT REG 18
INPUT REG 19
INPUT REG 20
INPUT REG 21
INPUT REG 22
INPUT REG 23
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INPUT REG 38
INPUT REG 39
INPUT REG 40
INPUT REG 145
INPUT REG 146
INPUT REG 147
INPUT REG 148
INPUT REG 149
INPUT REG 150
INPUT REG 151
INPUT REG 152
INPUT REG 153
INPUT REG 154
INPUT REG 155
INPUT REG 156
INPUT REG 157
INPUT REG 158
INPUT REG 159
INPUT REG 160
CABLE A
CABLE B
MTB
P/O ATB-1
P/O ATB-2
P/O ATB-3
P/O ATB-8
P/O ATB-9
TO MTB-17 PIN 17
TO/FROM DR11-C IN OPPOSITE TERMINAL HALF
TO HIGH SPEED PAPER TAPE READER OR READER / PUNCH
SPS7019211 INSTALL ALARM CABLE
NKN6193A DATA TRANSFER MODULE CABLES
TO AN AC DISTRIBUTION PANEL
LOCAL TELETYPEWRITER
REAR
POWER SUPPLY
DISC SYSTEM
MAGNETIC TAPE UNIT
DISC CONTROLLER
DISC POWER SUPPLY
AC POWER CORD
TO NON SWITCHED AC SOURCE
SYSTEM UNIT
UNIBUS OUT
UNIBUS IN
16K CORE MEMORY EXPANSION SYSTEM (#1)
16K CORE MEMORY
SPC SLOT (A)
SPC SLOT (B)
SPC SLOT (C)
CPU BOARDS
TERMINATORS
FRONT
COMPUTER DRAWER
MAIN BACKPLANE
FIRST ACCESSORY DRAWER
SECOND ACCESSORY DRAWER
LAST ACCESSORY DRAWER
(LAST USED) SYSTEM UNIT
M930
DATA SET CONNECTOR BOARD = NLN8284A
LB = DIAL INPUT/END-TO-END LOOP BOARD
NLN8293A NLN8293A
LR = DIAL INPUT/END-TO-END LINE RECEIVER
NLN8293 A/NLN8293 A
DATA SET FUSE PANEL = NLN8328A
(ABOVE ITEMS VIEWED TOWARDS FRONT OF TERMINAL/TERMINAL-HALF)
INPUT CONNECTOR BLOCK = NLN8290A
INPUT REGISTER = NLN8289A
ADDRESS DECODER = NLN8286A
INTERRUPT CONTROL = NLN8287A
P/O NLN8354A ALARM PANEL RACK
#12V #5V GND
CONNECTOR SLOT (FRONT CONNECTORS)
"C" 3 (PS3)
"C" 4 (PS4)
"C" 5 (PS5)
"A" 9 (LOS 65-72)
"A" 10 (LOS 73-80)
"A" 11 (LOS 81-88)
"A" 12 (LOS 89-96)
"A" 13 (LOS 97-104)
"A" 16 (LOS 105-112)
"A" 15 (LOS 113-120)
"A" 16 (LOS 121-128)
"A" 17 (LOS 129-136)
"A" 18 (LOS 137-144)
"A" 19 (LOS 145-152)
"A" 20 (LOS 153-160)
"B" 5 (O/U NO. 5)
EXPANSION
SPS7019251 ALARM BD "C" CABLE
NKN6168A
SPS7019251
NKN6168A ALARM BD "A" CABLE
NKN6168A
NKN6178A EXPANSION CABLE
"A" = ALARM BOARD "A" NLN8350A
"B" = ALARM BOARD "B" NLN8351A
"C" = ALARM BOARD "C" NLN8352A
"D" = ALARM BOARD "D" NLN8353A
LOCKOUT BOARD = NLN8345A
NKN6167 A BASIC ALARM PANEL CABLE
NKN6168 A ALARM BD "A" CABLE
NKN6168 A
TO ATB1-13
TO ATB1-14
TO ATB2-13
TO ATB2-14
TO ATB3-13
TO ATB3-14
NKN6167A ALARM BD "B" CABLE
NKN6169 A
TO ATB1-13
TO ATB1-14
NKN6167A ALARM BD "C" CABLE
TO MTB-17
TO ATB2-13
MAJOR ALARM EXTERNAL CONTACTS
-48V FROM EXTERNAL SOURCE
NLN8767 A CONTROL SWITCH
INTERNAL +5V POWER
-130V FROM EXTERNAL SOURCE
INTERNAL -130V POWER
MTB = NLN8339A
EACH ATB = NLN8568A
OUTPUT UNIT CABLE
NLN8335 A TCU CARD RACK
(TCU'S 1-8)
NKW6173A TCU EXPANSION CABLE
NLN8507A TCU EXPANSION CARD RACK
(TCU'S 9-16)
NKN6173A I/O EXPANSION CABLE
(TCU'S 17-24)
TO 115/116 OF ATB-1
TO 115/116 OF ATB-2
SECOND OUTPUT UNIT
O/U CABLE
TO J17 OF ATB-1
TO 115/116 OF ATB-n
FIFTH OUTPUT UNIT
TO J17 OF ATB-n
NKN6173A
NLN8507A
OUTPUT BUS
ANNUNCIATOR ALARM DECODER
TO AN AC DISTRIBUTION PANEL
INPUT TEST RACK
NLN8332A BASIC INPUT TEST UNIT
OVERVOLTAGE PROTECTORS
FIRST SYSTEM POWER SUPPLY
SECOND SYSTEM POWER SUPPLY
FIFTH SYSTEM POWER SUPPLY
NKN6170A POWER CONTROL CABLE (PS1)
NKN6170A POWER CONTROL CABLE (PS2)
NKN6170A POWER CONTROL CABLE (PS5)
NKN6170A EXPANSION CABLES
AC DISTRIBUTION PANEL NO. 1
AC DISTRIBUTION PANEL NO. 2
AC DISTRIBUTION PANEL NO. 5
TO AN AC DISTRIBUTION PANEL
TO TELEPHONE LINE INPUT/OUTPUT MTB/ATB PINS IN OPPOSITE TERMINAL HALF
TO MTB SLOT 10 PIN P IN OPPOSITE TERMINAL HALF (W/A REDUNDANT SWITCHBOARD IN THAT HALF)
NLN8701 REDUNDANT SWITCHBOARD MOUNTING PANEL
CIRCLES SHOW WIREWRAP CONNECTION POINTS ON A CONNECTOR OF THE NLN8701
OUTPUT BUSY SIGNAL
TO MTB SLOT 10 PIN P IN THIS TERMINAL HALF
TO INPUT TELEPHONE LINES AND TELEPHONE LINES TO/FROM PAGING TRANSMITTERS
TO TELEPHONE LINE INPUT/OUTPUT MTB/ATB PINS IN THIS TERMINAL HALF
RELAY COIL CONTROL TO ALARM BOARD "C" (1) IN ALARM PANEL (1 TO PIN 2, A TO PIN M)
RED
BLK
10 A
NOTES:
L LEGEND
P/O = PART OF
GA = GO AHEAD
RB = RINGBACK
O/U = OUTPUT UNIT
MTB = MASTER TERMINAL BLOCK
ATB-R = AUXILIARY TERMINAL BLOCK NUMBER
(WW) = MTB/ATB CONNECTION MADE BY WIRE-WRAPPING TO A BLOCK TERMINAL POST
→ = MTB/ATB CONNECTION MADE BY INSERTION OF A CABLE CONNECTOR CARD INTO A CONNECTOR SLOT.
1. DIAGRAM IS APPLICABLE TO SINGLE TERMINAL/SINGLE-HALF OF A REDUNDANT TERMINAL CONFIGURATION.
2. FOR MOST FIELD EXPANSIONS, ONE OR MORE NLN8000/NLN4000/NKN6000 SERIES (INDIVIDUAL-ITEM) KIT NUMBERS ARE REFERENCED UNDER AN NLN1000 SERIES (MAIN-KIT) NUMBER.
4. TRIANGLE-ENCLOSED NUMBERS (1, 2, ETC) REFER TO SPECIFIC REFERENCE NOTES EXPLAINED IN THE ADDITIONAL SHEETS OF THIS DRAWING: EPF-7239.
X = NORMALLY OPEN CONTACTS; CLOSED WHEN NO MAJOR ALARM.
= NORMALLY CLOSED CONTACTS OPEN WHEN NO MAJOR ALARM

Figure 3-2 (Sheet 1 of 2) "Metro-Page" 10/100 Intercabling Diagram

EEPF-7194 A

1 LOCAL TELETYPEWRITER SUPPLIED WITH ANY "METRO PAGE" 10/100 CONFIGURATION

PRIMARY POWER	KIT NUMBER
115 V 60 Hz	SP570472101
230 V, 50 Hz	PLN6154A

2 ONE OF FOLLOWING DISC SYSTEMS SUPPLIED WITH "METRO PAGE" 100 CONFIGURATIONS (ONLY)

PRIMARY POWER	TYPE	KIT NUMBER
115 V, 50 60 Hz	"SMALL"	NLN1230A
230 V, 50 60 Hz	"SMALL"	
115 V, 50 60 Hz	"LARGE"	NLN1231A
230 V, 50 60 Hz	"LARGE"	NLN1231A SP01

3 ONE OF FOLLOWING MAGNETIC TAPE SYSTEMS MAY BE OPTIONALLY SUPPLIED WITH "METRO PAGE" 100 CONFIGURATIONS (ONLY)

PRIMARY POWER	KIT NUMBER
115V 50 60 Hz	PLN1010A
230V, 50 60 Hz	PLN1011A

4 UNIBUS CONNECTOR CABLE ONE NKN6227A EIGHT FT CABLE SUPPLIED WITH EACH COMPUTER/ ACCESSORY DRAWER ONE NKN6181A 15 FT CABLE SUPPLIED WITH EACH DISC SYSTEM CONNECTION AT COMPUTER DRAWER IS TO "UNIBUS OUT" OF EITHER THE 16K CORE MEMORY, 16K CORE MEMORY EXPANSION, OR (FIRST) SYSTEM UNIT ALL PERIPHERALS MUST BE SERIES LINKED USING UNIBUS CONNECTOR CABLES AND NKN6166A (DEC M920) UNIBUS JUMPER MODULES (AN NKN6166A INTER CONNECTS "UNIBUS OUT" OF A SYSTEM UNIT PERIPHERAL TO "UNIBUS IN" OF THE ADJACENT SYSTEM UNIT PERIPHERAL)

5 "UNIBUS OUT" POSITION IN LAST USED SYSTEM UNIT PERIPHERAL MUST CONTAIN A DEC M930 UNIBUS TERMINATOR

6 THE COMPUTER DRAWER IS SUPPLIED WITH AN SP570192140 STALL ALARM BOARD INSTALLED IN KM11 SLOT A THE SP570192141 STALL ALARM CABLE IS AN 8 FT LENGTH OF WIRE WHICH CONNECTS FROM THIS BOARD (VIA WIREWRAP) TO MASTER TERMINAL BLOCK CONNECTOR 17 PIN 17

7 IN REDUNDANT TERMINAL CONFIGURATIONS, THE COMPUTER DRAWER IN EACH TERMINAL HALF IS SUPPLIED WITH AN NLN8889A (DEC DR11 C) DATA TRANSFER MODULE INSTALLED IN THE FIRST VACANT SPC SLOT OF THE COMPUTER DRAWER TWO 15 FOOT NKN6193A DATA TRANSFER MODULES CABLES ARE USED TO INTERCONNECT THESE DATA TRANSFER MODULES THE OPPOSITE END OF THE CABLE INSERTED INTO CONNECTOR 1 OF THE DR11 C CARD IN TERMINAL HALF A MUST BE INSERTED INTO CONNECTOR 2 ON THE DR11 C CARD OF TERMINAL HALF B AND VICE VERSA A DEC G727 BUS GRANT CONTINUITY MODULE MUST REMAIN IN EACH UNUSED SMALL PERIPHERAL CONTROLLER (SPC) SLOT (CONNECTOR D POSITION)

8 IN TERMINALS EQUIPPED WITH AN NLN8889A SP03 HIGH SPEED PAPER TAPE READER OR AN NLN8889A HIGH SPEED PAPER TAPE READER/PUNCH, THE INTERFACE CARD INCLUDED WITHIN EITHER OF THESE KITS IS INSTALLED IN THE FIRST VACANT SPC SLOT OF THE COMPUTER DRAWER AND THE SINGLE CABLE OF THE READER OR THE TWO CABLES OF THE READER PUNCH IS (ARE) CONNECTED TO THIS CARD A DEC G727 BUS GRANT CONTINUITY MODULE MUST REMAIN IN EACH UNUSED SPC SLOT (CONNECTOR D POSITION)

9 LOCATED IN A COMPUTER/ACCESSORY DRAWER "SYSTEM UNIT" POSITION, COMBINATIONS OF THE PERIPHERAL DEVICE/INTERFACE ITEMS SHOWN IN DETAIL "A" ARE USED IN "METRO PAGE" 10/100 TERMINALS

10 INCOMING TELEPHONE LINE WIREWRAP POINT

11 OUTGOING TELEPHONE LINE WIREWRAP POINT

12 DESTINATION OF OUTPUT UNIT CABLE AND ALARM BOARD "B" CABLE (SECOND THROUGH FIFTH OUTPUT UNITS) DEPENDS ON CUMULATIVE NUMBER OF TCU'S USED ACCORDING TO THE PATTERN IN DETAIL B FOR A GIVEN OUTPUT UNIT (BEYOND THE FIRST) CABLES FROM THE NLN8335A TCU CARD RACK INSERT INTO SLOTS J15/J16 OF THE SAME ATB TO WHICH THAT OUTPUT UNIT CONNECTS (E G ATB q) CABLES FROM AN ASSOCIATED (FIRST) NLN8507A TCU EXPANSION CARD RACK ARE TO J15/J16 OF A NEXT FOLLOWING ATB (ATB q + 1). CABLES FROM AN ASSOCIATED (SECOND) NLN8507A RACK ARE TO J15/J16 OF A NEXT FOLLOWING ATB (ATB q + 2) THE ALARM BOARD "B" CABLE ASSOCIATED WITH THE GIVEN OUTPUT UNIT INSERTS INTO SLOT J13 OF THE SAME ATB TO WHICH THAT OUTPUT UNIT CONNECTS

13 TRANSMITTER CONTROL UNITS (TCU'S) AVAILABLE FOR USE IN TCU/TCU EXPANSION CARD RACKS

TYPE	TCU	REMARKS
DC TCU	NLN8334A SP03	USED WITH DFDD OUTPUT UNITS REQUIRES A 48 V POWER SUPPLY ON 2500 OHM CONTROL LOOP 125 V POWER SUPPLY ON 2500 8000 OHM CONTROL LOOP
TONE TCU	NLN8333A SP03	USED WITH DFDD OUTPUT UNITS
BINARY TCU	NLN8748A	USED WITH BINARY OUTPUT UNITS

THE LAST TCU/TCU EXPANSION RACK FOR ANY GIVEN OUTPUT UNIT MUST ALSO INCLUDE AN NLN8356A TCU TERMINATOR CARD

14 15 INPUT TEST RACK EQUIPMENT IN THESE LOCATIONS DEPENDS ON DATA SET USAGE AS FOLLOWS

DATA SET USAGE	LOCATION 14	LOCATION 15
DIAL INPUT DATA SETS ONLY	NLN8553A END TO END INPUT TEST BLANK PANEL	NLN8323A DIAL INPUT TEST UNIT
END TO END DATA SETS ONLY	NLN8322A END TO END INPUT TEST UNIT*	NLN8554A DIAL INPUT TEST BLANK PANEL
BOTH DIAL INPUT AND END TO END DATA SETS	NLN8322A END TO END INPUT TEST UNIT*	NLN8323A DIAL INPUT TEST UNIT

*NLN8322A KIT ALSO INCLUDES RINGING GENERATOR MODULE ATTACHED AT A 115V 50 60 HZ OUTLET OF AN AC DISTRIBUTION PANEL

16 26 IN SHARED RF CHANNEL REDUNDANT TERMINAL CONFIGURATIONS, OUTPUT BUSY LEADS FROM ALL OUTPUT UNITS MUST BE PARALLELED AND MUST BE WIREWRAPPED (VIA THE REDUNDANT SWITCHBOARDS) TO MTB CONNECTOR, 10 PIN P AND RUN TO THE SAME CONNECTOR/PIN ON THE OPPOSITE TERMINAL HALF'S MTB.

17 IN TERMINAL BLOCK EXPANSIONS, ONE OR TWO NKN6179A EXPANSION CABLES ARE USED AS FOLLOWS

EXPANSION	NO OF NKN6179A'S	MTB SLOT	ODD NO ATB SLOT	EVEN NO ATB SLOT
MTB TO ATB NO. 1	2	5	18 (ATB NO. 1)	– – –
		6	19 (ATB NO. 1)	– – –
ODD NO ATB TO EVEN NO ATB	1	– – –	1	18
		– – –	1	18
EVEN NO ATB TO ODD NO ATB	2	– – –	2	19

18 ONE OF THE FOLLOWING SYSTEM POWER SUPPLIES USED PER EACH TWO TERMINAL BLOCK REQUIREMENT

PRIMARY POWER	KIT NUMBER
115V, 50 60 Hz	NPN6051A
230V 50 60 Hz	NPN6057A

POWER CONTROL CABLE (NKN6170A) INSERTS INTO MTB/ATB SLOT 19

19 ONE OF FOLLOWING AC DISTRIBUTION PANELS USED PER EACH 30A AC INTERFACE REQUIREMENT

PRIMARY POWER	AC DISTRIBUTION PANEL
115V 50 60 Hz	NLN8395A
230V, 50 60 Hz	NLN8560A

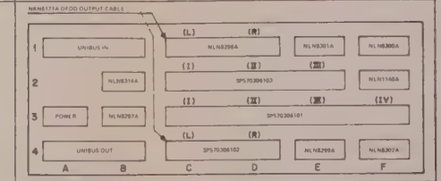
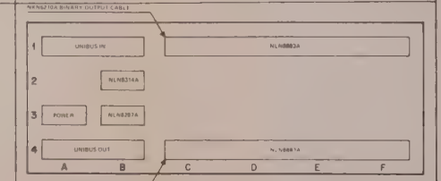
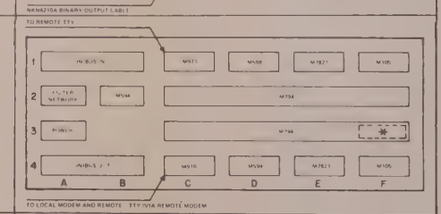
20 -48V POWER IS REQUIRED FOR DIAL INPUT DATA SETS AND DC TCU'S USED WITH A LESS THAN 2500 OHM CONTROL LOOP WHEN CUSTOMER SUPPLIED, AN NLN8767A CONTROL SWITCH INTERFACES EVERY TWO MTB/ATB TERMINAL BLOCKS AND AN EXTERNAL SUPPLY WHEN INTERNALLY SUPPLIED, ONE NPN1017A -48V POWER SUPPLY IS USED FOR EVERY TWO MTB ATB TERMINAL BLOCKS -48V DATA SET POWER/-48V POWER SUPPLY ALARM CONNECTIONS ARE VIA WIRE WRAP TO MTB CONNECTORS 1 AND 2 PINS 17 (-48V) AND 18 (-48V RETURN) AND (AS REQUIRED) TO CONNECTOR 1 PINS T/U (-48V) AND CONNECTOR 2 PINS Z/20 (-48V RETURN) OF EVEN NUMBERED ATB'S (ATB 2, 4, 6,) TCU RACK -48V POWER (WHEN REQUIRED) IS ROUTED VIA THE SEVEN FOOT -48V CABLE (WHITE = -48V/BLACK = -48V RETURN) OF EACH TCU RACK TO EITHER A -48V CONTROL SWITCH OR AN INTERNAL NPN1022A SUPPLY.

21 -130V POWER IS REQUIRED FOR DC TCU'S WITH A 2500 8000 OHM CONTROL LOOP WHEN CUSTOMER SUPPLIED, AN NLN8767A CONTROL SWITCH INTERFACES EVERY TWO MTB/ATB TERMINAL BLOCKS AND AN EXTERNAL SUPPLY WHEN INTERNALLY SUPPLIED, AN NPN1016A -130V POWER SUPPLY (IF LOAD CURRENT < 2A) OR AN SP SUPPLY (IF LOAD CURRENT >2A) IS USED PER EVERY TWO MTB/ATB TERMINAL BLOCKS -130V POWER SUPPLY ALARM CONNECTIONS ARE VIA WIRE WRAP TO MTB CONNECTOR 8 PINS 21 (-130V) AND 22 (-130V RETURN) AND (AS REQUIRED) TO CONNECTOR 1 PIN W (-130V) AND CONNECTOR 2 PIN Z (-130V RETURN) OF EVEN NUMBERED ATB'S (ATB 2, 4, 6,) TCU RACK -130V POWER IS ROUTED VIA THE SEVEN FOOT -130V CABLE (BLUE = -130V/BLACK = -130V RETURN) OF EACH TCU RACK TO EITHER A -130V CONTROL SWITCH OR AN INTERNAL -130V POWER SUPPLY

22 THE NKN6167A BASIC ALARM PANEL CABLE IS SUPPLIED WITH POWER, ALARM BOARD "C" 1, ALARM BOARD "D" 1 AND ALARM BOARD "D" 2 LEADS PRESOLDERED TO THE CABLE CONNECTOR CARD WHICH INSERTS INTO MTB SLOT 17 THE NKN6168A LEADS FROM ALARM BOARD "A" 1 AND THE NKN6196A LEADS FROM ALARM BOARD "B" 1 ARE ADDITIONALLY SOLDERED TO THIS CABLE CONNECTOR CARD

23 THE NKN6168A CABLE LEADS FROM ALARM BOARD "A" 2 (ASSOCIATED WITH LINE OUT OF SERVICE "LOS" ALARMS 9 16) ARE SOLDERED TO A CABLE CONNECTOR CARD WHICH INSERTS INTO MTB SLOT 7 WHEN A LOCKOUT BOARD IS PRESENT IN THE TERMINAL THE NKN6182A LOCKOUT CABLE LEADS ARE ADDITIONALLY SOLDERED TO THIS CABLE CONNECTOR CARD

DETAIL "A"

ITEM	CONNECTOR BLOCK KIT NUMBER	SYSTEM UNIT CONFIGURATION (VIEW TOWARDS PLUG-IN SIDE OF CONNECTORS)
INPUT UNIT	NLN8290A	AS SHOWN IN DIAGRAM
DUAL FUNCTION DECIMAL DIGITAL (DFDD) OUTPUT UNIT	SP570306104	 NKN6177A DFDD OUTPUT CABLE UNIBUS IN NLN8296A NLN8301A NLN8305A NLN8316A SP570306103 NLN1146A POWER NLN8287A SP570306101 UNIBUS OUT SP570306102 NLN8295A NLN8307A A B C D E F
BINARY OUTPUT UNIT	NLN8884A*	
DC11 DC REMOTE TELETYPEWRITER INTERFACE (NLN4227A)	NLN8743A**	 NKN6210A BINARY OUTPUT CABLE TO REMOTE TTY UNIBUS IN M9311 M7820 M105 M7940 M7941 M7942 M7943 M7944 M7945 M7946 M9310 M9312 M105 A B C D E F TO LOCAL MODEM AND REMOTE TTY (VIA REMOTE MODEM
DC11 MODEM REMOTE TELETYPEWRITER INTERFACE INCLUDING LOCAL MODEM (NLN4226A)		
DB11-A UNIBUS REPEATER***	– – –	SEE DEC DOCUMENTATION

* A SINGLE NLN8884A ACCOMMODATES UP TO TWO BINARY OUTPUT UNITS

** A SINGLE NLN8743A ACCOMMODATES UP TO TWO TELETYPEWRITER INTERFACES (ANY COMBINATION OF DC/MODEM TYPES PERMITTED) CONFIGURATION ILLUSTRATED HERE HAS A DC INTERFACE IN ROWS 1 AND 2, A MODEM INTERFACE IN ROWS 3 AND 4 IF ONLY THE ROW 1 AND 2 INTERFACE IS USED, A DEC G727 BUS GRANT CONTINUITY MODULE MUST BE INSERTED IN SLOT F3 (SHOWN DOTTED)

*** A DB11-A UNIBUS REPEATER IS REQUIRED WHENEVER THE TERMINAL CONTAINS MORE THAN 19 "BUS LOADS" OR 50 FT. OF UNIBUS CABLE (SEE DEC DOCUMENTATION) THE DB11 A SHOULD BE PLACED IN AN ACCESSORY DRAWER SYSTEM UNIT POSITION ADJACENT TO THE DRAWER'S POWER SUPPLY

24 SLOT 13 OF EACH ATB ACCOMMODATES AN "ALARM BOARD COMBINATION CABLE" FORMED FROM ANY (OR ALL) OF THE FOLLOWING THREE CABLES

AN NKN6168A ASSOCIATED WITH ONE ALARM BOARD "A" EXPANSION
AN NKN6196A ASSOCIATED WITH ONE ALARM BOARD "B" EXPANSION
AN SP570192151 ASSOCIATED WITH ONE ALARM BOARD "C" EXPANSION

(THE CABLE(S) INVOLVED IS(ARE) SOLDERED TO A SINGLE CABLE CONNECTOR CARD)

25 SLOT 14 OF EACH ATB ACCOMMODATES AN NKN6168A CABLE ASSOCIATED WITH ONE ALARM BOARD "A" EXPANSION

26 IN REDUNDANT TERMINAL CONFIGURATIONS, ONE OR MORE NLN8701A REDUNDANT SWITCHBOARD MOUNTING PANELS ARE REQUIRED IN EACH TERMINAL HALF EACH NLN8701A ACCOMMODATES UP TO EIGHT (TOTAL) TYPE NLN8700A REDUNDANT SWITCHBOARDS AND/OR TYPE NLN8876A TCU IMPEDANCE MATCHING BOARDS EACH NLN8700A PROVIDES 12 SETS OF DOUBLE THROW (NORMALLY CLOSED PLUS NORMALLY OPEN) CONTACTS FOR MAKING REDUNDANCY RELATED INTERCONNECTIONS

DETAIL "B"

CABLE ASSOCIATED WITH	AND TCU'S USED WITH FIRST O/U	AND TCU'S USED WITH SECOND O/U	AND TCU'S USED WITH THIRD O/U	AND TCU'S USED WITH FOURTH O/U	AND TCU'S USED WITH FIFTH O/U	RESULT IN O/U CABLE INSERTING INTO ATB
SECOND O/U	1-8					1
	9-16					2
	17-24					3
THIRD O/U	1-8	1-8				2
		9-16				3
		17-24				4
	9-16	1-8				3
		9-16				4
		17-24				5
	17-24	1-8				4
		9-16				5
		17-24				6
FOURTH O/U	1-8	1-8	1-8			3
			9-16			4
			17-24			5
		9-16	1-8			4
			9-16			5
			17-24			6
		17-24	1-8			5
			9-16			6
			17-24			7
	9-16	1-8	1-8			5
			9-16			6
			17-24			7
		9-16	1-8			6
			9-16			7
			17-24			8
		17-24	1-8			7
			9-16			8
			17-24			9
FIFTH O/U	1-8	1-8	1-8	1-8		4
				9-16		5
				17-24		6
			9-16	1-8		5
				9-16		6
				17-24		7
			17-24	1-8		6
				9-16		7
				17-24		8
		9-16	1-8	1-8		5
				9-16		6
				17-24		7
			9-16	1-8		7
				9-16		8
				17-24		9

ETC

27 ANNOUNCEMENT RECORDER OPTIONS

RECORDED MESSAGE TYPE	MAIN KIT	RECORDER CABLE INTER CONNECTION POINTS ON MTB			REMARKS
		AUDIO IN	GND	GND START	
INVALID VOICE	NLN1137A	18-K	19-13	15-D	KIT'S NLN8325A RECORDER CONTROL BOARD INSERTS INTO SLOT 2 OF BASIC INPUT TEST UNIT'S CARD RACK RECORDER ENABLED AS REQUIRED BY DATA SETS
VALID VOICE	NLN1137A	18-Y	19-20	19-20	KIT'S NLN8325A RECORDER CONTROL BOARD INSERTS INTO SLOT 5 OF BASIC INPUT TEST UNIT'S CARD RACK RECORDER PERMANENTLY ENABLED
AUTOMATIC VOICE STATION IDENTIFICATION (VOICE ASI)	NLN1107A	18-T	19-17	18-W	KIT'S NLN8326A ASI CONTROL INSERTS INTO SLOT 3 OF BASIC INPUT TEST UNIT'S CARD RACK, RECORDER ENABLED AS REQUIRED BY THE ASI CONTROL

*REQUIRES 115V, 60 Hz/230V, 50 Hz (FOR MOTOR) AND -48V (FOR CIRCUITS)

EPF-7239 A

Figure 3-2 (Sheet 2 of 2) "Metro-Page" 10/100 Intercabling Diagram Notes

Additional requirements include; isolation from transients, electrically noisy equipment, and power surges.

3.7.2 Connections

Perform the following steps relating to terminal power connections:

CAUTION

Be sure that the main power circuit breakers on all ac distribution panels in the rear of the terminal are OFF at this time. If any power wiring is required, it should be done only by a qualified electrician with all customary precautions and electrical codes observed.

Step 1. Install the primary power cable of each ac distribution panel.

Step 2. Clamp a braided ground strap to earth ground and connect this ground strap to the frame at the rear of the terminal. Scrape away the paint at this point and use a star washer to insure good contact.

Step 3. Connect externally supplied -48 V/-130 V power sources as follows:

- Terminals Using Customer Supplied -48 V

Connect the external -48 V power source(s) to the -48 V-designated NLN8767A Control Switch(es) in each terminal half and wrap the leads from the control switch(es) to MTB 1-17/2-17 (-48 V) and MTB 1-18/2-18 (-48 V RETURN) and to 1-T/2-T (-48 V) and 1-Z/2-Z (-48 V RETURN) for subsequent even-numbered ATB's (ATB 2, 4, 6,...), when used. Connect (as required) each 7 ft. -48 V power cable from the respective TCU/TCU-expansion racks to the -48 V-designated NLN8767A tie points. (WHITE wires to -48 V; BLACK wires to -48 V RETURN.)

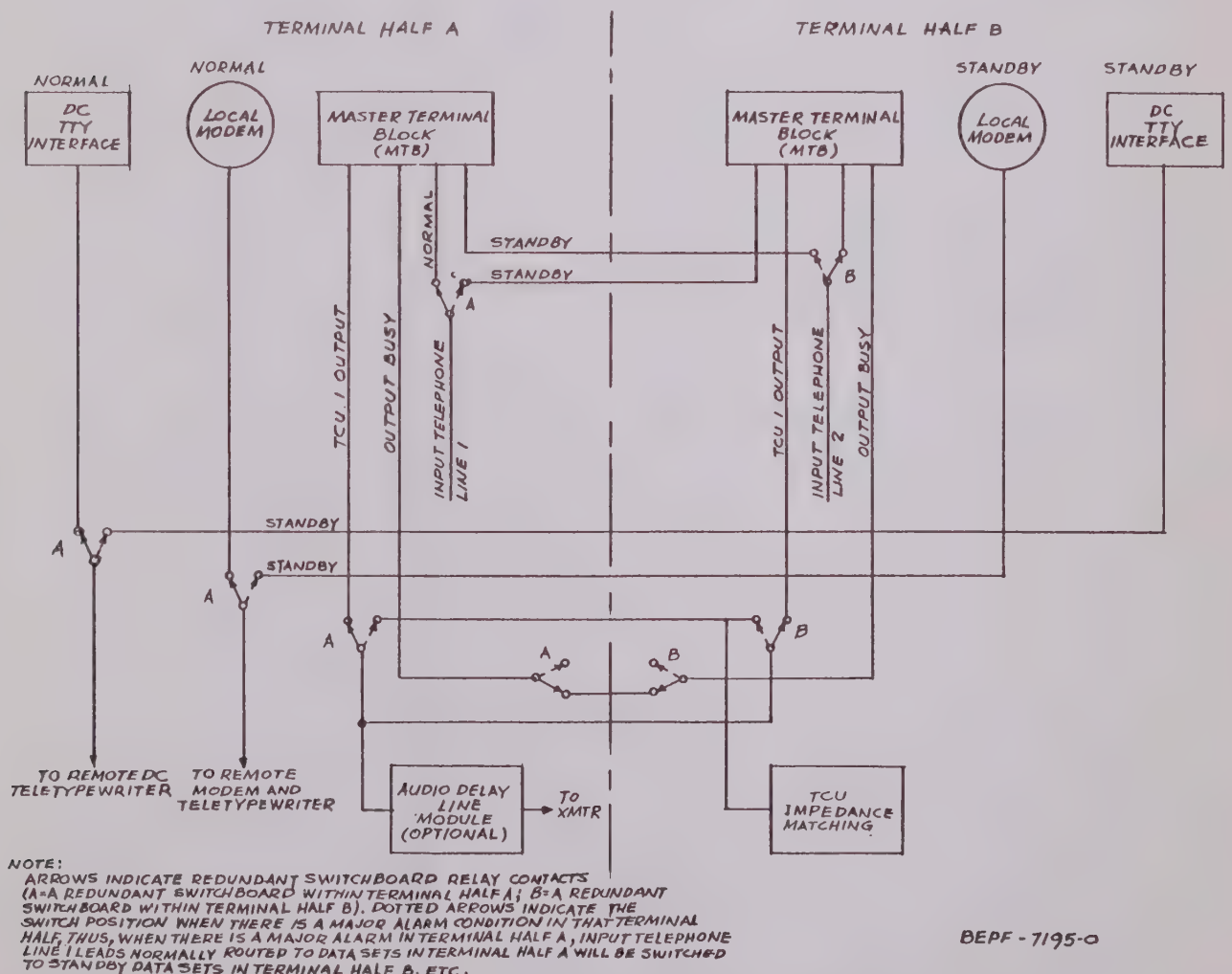

TERMINAL HALF A
TERMINAL HALF B
NORMAL
DC TTY INTERFACE
NORMAL
LOCAL MODEM
MASTER TERMINAL BLOCK (MTB)
MASTER TERMINAL BLOCK (MTB)
STANDBY
LOCAL MODEM
STANDBY
DC TTY INTERFACE
NORMAL
STANDBY
STANDBY
TCU I OUTPUT
OUTPUT BUSY
INPUT TELEPHONE LINE 1
TCU I OUTPUT
INPUT TELEPHONE LINE 2
OUTPUT BUSY
STANDBY
STANDBY
A
A
A
B
B
A
B
TO REMOTE DC TELETYPEWRITER
TO REMOTE MODEM AND TELETYPEWRITER
AUDIO DELAY LINE MODULE (OPTIONAL)
TO XMTR
TCU IMPEDANCE MATCHING
NOTE:
ARROWS INDICATE REDUNDANT SWITCHBOARD RELAY CONTACTS (A=A REDUNDANT SWITCHBOARD WITHIN TERMINAL HALF A; B=A REDUNDANT SWITCHBOARD WITHIN TERMINAL HALF B). DOTTED ARROWS INDICATE THE SWITCH POSITION WHEN THERE IS A MAJOR ALARM CONDITION IN THAT TERMINAL HALF, THUS, WHEN THERE IS A MAJOR ALARM IN TERMINAL HALF A, INPUT TELEPHONE LINE 1 LEADS NORMALLY ROUTED TO DATA SETS IN TERMINAL HALF A WILL BE SWITCHED TO STANDBY DATA SETS IN TERMINAL HALF B, ETC.
BEPF - 7195-0

Figure 3-3. General Interconnection Diagram for Redundant Systems

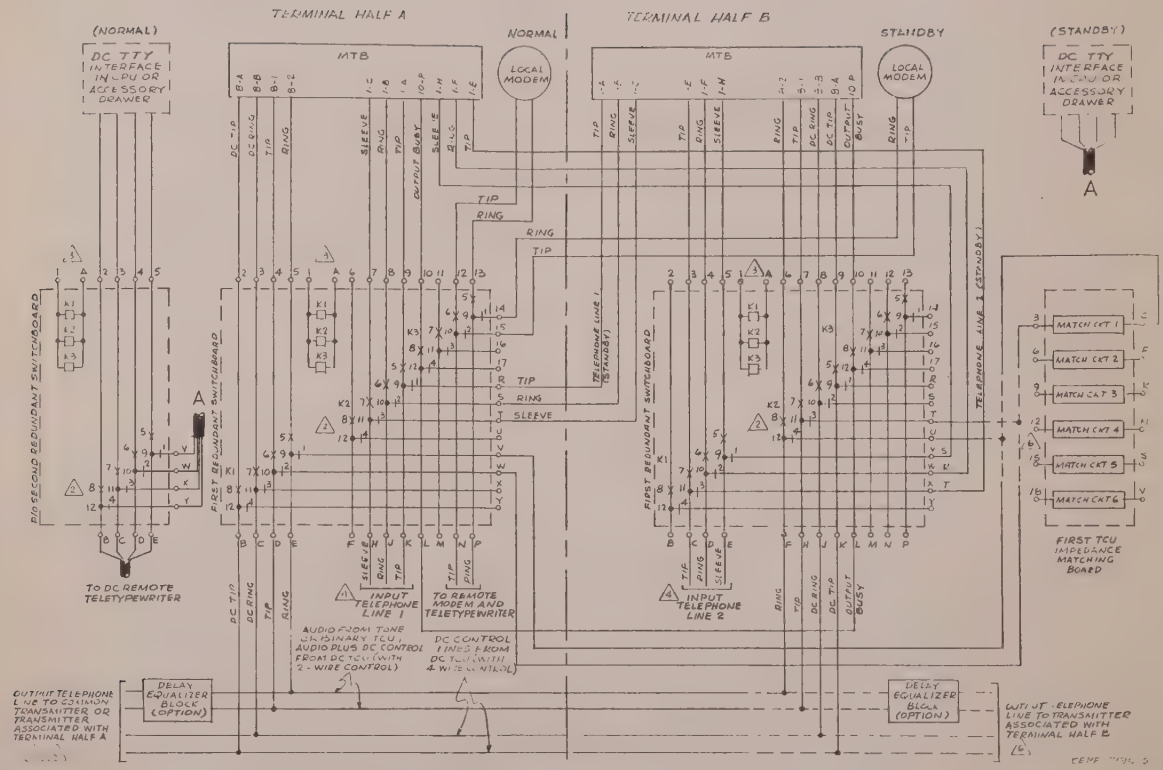


Figure 3-4. Typical Redundant Interconnections Diagram (and Notes)

NOTES FOR TYPICAL REDUNDANT INTERCONNECTIONS DIAGRAM

1. CIRCLES (o) INDICATE TERMINAL POST CONNECTION POINTS ON CONNECTORS WITHIN ONE OR MORE NLN8701A REDUNDANT SWITCHBOARD MOUNTING PANELS (THESE CONNECTIONS ARE ROUTED VIA THE MOUNTING PANEL CONNECTORS EITHER TO NLN8700A REDUNDANT SWITCHBOARD RELAY CONTACTS OR IMPEDANCE MATCHING CIRCUITS WITHIN NLN8876A TCU MATCHING BOARDS - - AS SHOWN.)

2. x = NORMALLY OPEN CONTACT (WHEN RELAY DE-ENERGIZED - - I.E. DURING MAJOR ALARM CONDITION)
   I = NORMALLY CLOSED CONTACT (WHEN RELAY DE-ENERGIZED - - I.E. DURING MAJOR ALARM CONDITION)

3. WITHIN EACH TERMINAL HALF, ALL REDUNDANT SWITCHBOARD RELAY COIL CONNECTIONS (PINS 1 AND A) MUST BE WIRE-WRAPPED IN PARALLEL WITH PINS 1 CONNECTING TO BOTTOM PIN OF ALARM PANEL'S +12V FUSE (F1); PINS A CONNECTING TO PIN H OF ALARM PANEL'S ALARM BOARD "C"1. THUS DURING NORMAL TERMINAL HALF OPERATION, ALL RELAYS ON EVERY REDUNDANT SWITCHBOARD OF THAT TERMINAL HALF ARE ENERGIZED; DURING A MAJOR ALARM CONDITION IN THAT HALF, THE RELAYS DE-ENERGIZE TO MAKE THE APPROPRIATE "STANDBY" CONNECTIONS.

4. "ALL-SWITCHED" INPUT REDUNDANCY SCHEME SHOWN FOR TWO DIAL-INPUT TYPE TELEPHONE LINES HAVING TIP, RING, AND SLEEVE LEADS. (DIAL-INPUT LINES NOT USING THE SLEEVE LEAD REQUIRE ONLY TIP AND RING LEADS TO PASS THROUGH REDUNDANT SWITCHBOARD.) END-TO-END TYPE INPUT CONNECTIONS ARE SIMILARLY WIRED USING ONE REDUNDANT SWITCHBOARD INPUT FOR EACH OF TIP, RING, CG, CS -- USED.

5. FOR A NON-REDUNDANT TRANSMITTER CONTROL ARRANGEMENT (SINGLE COMMON PAGING TRANSMITTER ASSOCIATED WITH A PARTICULAR COMMON OUTPUT), EACH AUDIO/CONTROL OUTPUT CIRCUIT REQUIRES A SEPARATE TCU MATCHING CIRCUIT (COMMON TO BOTH TERMINAL HALVES), AND (WITHIN EACH SEPARATE TERMINAL HALF) TWO SETS OF REDUNDANT SWITCHBOARD CONTACTS (FOR A TONE TCU, BINARY TCU OR DC TCU WITH TWO-WIRE CONTROL); OR FOUR SETS OF REDUNDANT SWITCHBOARD CONTACTS (FOR A DC TCU WITH FOUR-WIRE CONTROL).

6. FOR A REDUNDANT TRANSMITTER CONTROL ARRANGEMENT (WITH A SEPARATE PAGING TRANSMITTER ASSOCIATED WITH EACH TERMINAL HALF), A SEPARATE SET OF AUDIO/CONTROL CONNECTIONS IS MADE FROM EACH TERMINAL HALF VIA APPROPRIATE REDUNDANT SWITCHBOARD CONTACTS, AND NO TCU IMPEDANCE MATCHING CIRCUIT (OR ASSOCIATED WIRING) IS REQUIRED.

EPF-7264-O

- Terminals Using Customer Supplied -130 V

  Connect the external -130 V power source(s) to the -130 V-designated NLN8767A Control Switch(es) in each terminal half and wrap the leads from the control switch(es) to MTB 8-21 (-130 V) and MTB 8-22 (-130 V RETURN) and to 1-W (-130 V) and 2-Z (-130 V RETURN) for subsequent even-numbered ATB's (ATB 2, 4, 6, ...), when used. Connect each 7 ft. -130 V power cable from the respective TCU/TCU-expansion racks to the -130 V-designated NLN8767A tie points. (BLUE wires to -130 V. BLACK wires to -130 V RETURN.)

Step 4. Insure that the line cords from the computer drawer; accessory drawers; power supplies; etc., are all plugged into an ac distribution panel slot.

3.8 INPUT/OUTPUT CONNECTIONS (FOR SYSTEMS WITHOUT T & I BAY)

3.8.1 General

Input/output lines are often wire wrapped to the connector pin terminals of the MTB or ATB's. The MTB/ATB's can be mounted in the equipment rack in either of two positions; either the terminal blocks will be mounted horizontally with the wire wrap pins extending up, or they will be rotated 90 degrees and mounted vertically with the wire wrap pins extending back towards the rear of the equipment rack. In both cases, J1 is the first connector on the left with the connector designators incrementing sequentially to the right. Each connector requires 44 wire wrap pins (two rows of 22 each). The left row is designated A thru Z. Vertically mounted terminal blocks have pins 1 and A on top and pins 22 and Z on the bottom. (Horizontally mounted MTB/ATB's will have pins 22 and Z closest to the rear of the equipment rack.)

NOTE

Letters G, O, I and Q are NOT used as designators. Within this documentation, references to MTB/ATB connectors and/or connector pin terminals are generally in a shorthand format stating the terminal block followed by a connector number followed (as required) by a pin terminal designation. Thus, for example, MTB 9-1 references connector J9, pin terminal 1, of the master terminal block; ATB 1-7 references connector J7 of the first auxiliary terminal block; ATB 1-7-A references pin terminal A of connector J7 of the first ATB, etc.

NOTE

Although the printed circuit cable connector cards which insert into the MTB/ATB connectors use the same basic shorthand labeling as used when referencing the MTB/ATB connectors, the particular usage in each case will make it clear what is being referred to.

Input/output connections for redundant terminal configurations generally involve routing through redundant switchboard contacts as shown in Figure 3-2 "Metro-Page" 10/100 Intercabling Diagram; Figure 3-3 General Interconnection Diagram for Redundant Systems; and Figure 3-4 Typical Redundant Interconnections Diagram.

IMPORTANT

Due to the wide variety of specific interconnections possible with redundant switchboards, the redundancy-related interconnection diagrams, that are included, should be treated as guidelines only.

The following installation instructions are categorized into redundant-terminal and non-redundant-terminal paragraphs. Refer, in each case, to the paragraph applicable to your particular paging terminal configuration.

3.8.2 Input Telephone Lines

3.8.2.1 Non-Redundant Terminal Configurations

Input telephone line connections for non-redundant terminal configurations are made by wire wrap connections directly to MTB/ATB connectors. Referring to the MTB/ATB wiring diagrams (maintenance section) wrap the applicable of TIP, RING, SLEEVE, CG, and CS leads to the MTB/ATB connector terminal posts appropriate to the number and type of data sets used.

3.8.2.2 Redundant Terminal Configurations

Three general schemes are used to handle input telephone line connections for redundant terminal configurations. These are the "all-switched," the "split- input," and the "combination" type schemes.

In the "all-switched" type approach, each input telephone line assigned to a particular terminal half is normally connected via closed-in-non-alarm redundant switchboard contacts to the MTB telephone line input connection points within this terminal half. Should failure of this terminal half occur, the line is routed via the redundant switchboard contacts to the corresponding (standby) set of MTB telephone line input connection points in the opposite terminal half.

In the "split-input" redundancy scheme, the total number of input lines are generally divided equally between the two terminal halves, and the input lines assigned to each half are connected directly to the appropriate MTB telephone line input connection points of that half WITHOUT passing through redundant switchboard contacts. Terminal half failure, in this case, causes all input lines connected to the "downed" half to "busy-out". The telephone system must then route all incoming calls to the working terminal half.

The "combination" type input redundancy scheme, as the name implies, provides redundant switchboard contacts for some input line switching, in addition to direct MTB telephone line input connection points for the remainder of the telephone input lines.

The Typical Redundant Interconnection Diagram, Figure 3-4, includes an example of how the "all-switched" input redundancy scheme could be implemented for two input telephone lines labeled 1 and 2.

A detailed enumeration of all MTB/ATB input telephone line connection points appears in the MTB/ATB wiring diagrams located in the maintenance section of this manual. Refer to these diagrams to obtain the MTB/ATB wire-wrap points applicable to the specific paging terminal configuration.

NOTE

Each dial-input type telephone line requires TIP, RING, and possibly SLEEVE, CG, and CS connections; each end-to-end type line requires TIP, RING, and possible CG and CS type connections. Each of these signal leads must pass through redundant switchboard contacts where redundancy connections via a redundant switchboard are supplied.

3.8.3 Output Telephone Lines [to Paging Transmitter(s)]

3.8.3.1 Non-Redundant Terminal Connections

Output telephone line connections for non-redundant terminal configurations are made by wire-wrap connections directly to MTB/ATB connectors. Referring to the MTB/ATB wiring diagrams in the maintenance section, wire wrap the required TIP, RING, DC TIP, and DC RING leads to the MTB/ATB connector pins appropriate to the number/type of transmitter control circuits used.

3.8.3.2 Redundant Terminal Connections

Output telephone line connections for redundant terminal configurations (with non-redundant transmitter control lines) are made to MTB/ATB connectors via redundant switchboard contacts in each terminal half. The MTB/ATB connection points are supplied in the MTB/ATB wiring diagrams in the maintenance section. From these points, interconnect to the redundant switchboard contacts, then connect the telephone lines to the transmitter(s) per the typical example shown in Figure 3-4.

A single impedance matching circuit must be used with each redundant output interconnection (unless redundant transmitter control lines are used). Each R-C circuit provides a simulated 1200 ohm load (the same load presented by a TCU output circuit) so that a common transmitter control line will "see" 600 ohms (1200 ohms in parallel with 1200 ohms) in either normal operation or single terminal-half takeover. Six circuits are contained on each NLN8876A TCU Impedance Matching Board. Any of the six circuits can be used to provide the impedance matching needed for the installation; i.e., for each pair of TCU's used in the redundant system (one TCU in terminal half A and one in terminal half B), one R-C impedance matching circuit should be used as shown in the typical example, see Figure 3-4.

Connect the required TCU impedance matching circuits to their associated TCU output redundant switchboard contacts (within the same terminal half) with short lengths of #24 AWG solid wire, wire wrapped between the appropriate pins on the 44-pin connectors of the NLN8701A Redundant Switchboard Mounting Panel; interconnect each paralleled TCU output and the corresponding redundant switchboard contact pair in the opposite terminal half via available leads of the NKN6195A Cable Kit.

3.8.3.3 Delay Equalization (where applicable)

The output signals to certain paging transmitters may be selectively delayed to equalize the phase of all transmitted signals arriving in a particular coverage area. One or more NLN8945A Delay Equalizer Mounting Chassis together with one or more NLN6529A Delay Equalizer Blocks are required for this purpose.

Refer to the documentation supplied with the delay equalizing kits and install this equipment now.

NOTE

Final adjustment of delay parameters is done as part of the final preoperational checkout procedure within Section 4, the commissioning instructions.

3.8.4 DC Remote Teletypewriter Connections (where applicable)

Each DC remote teletypewriter associated with a particular terminal location should be installed within approximately 1500 ft. of that location. Refer to the DEC manual associated with the remote teletypewriter line interface mounting (system unit) for specific interconnection instructions.

NOTE

In redundant terminals, DC remote teletypewriter connections may be run through redundant switchboard contacts when opposite-terminal-half-takeover-upon-alarm is desired. Figure 3-4 includes an example of how this wiring should be implemented.

3.8.5 Modem Remote Teletypewriter Connections (where applicable)

Each modem-type remote teletypewriter interfaces with the main terminal location through a telephone line connected to a local modem. This telephone line may be run either directly from the corresponding local modem at the terminal half, or (in redundant terminals) from the local modem via redundant switchboard contacts of that terminal half. (The typical example in Figure 3-4 shows how the redundant approach can be implemented.)

Refer to the documentation supplied with the modems for specific telephone line connection information.

3.8.6 Lockout Kit Connections (where applicable)

The NLN1139A Lockout Kit enables the "Metro-Page" 10/100 paging system to share exisiting rf transmitter facilities with other radio services.

The number of lockout kits required in any system depends on how many different rf channels are to be shared. Usually a single common rf channel is shared, therefore, only one lockout kit is required within the "Metro-Page" 10/100 overall terminal. For this situation, the NLN8545A Lockout Board inserts into slot 16 of the basic alarm panel rack and interconnects via the NKN6188A Lockout Cable to connector 7 on the MTB.

NOTE

In redundant terminal configurations, the single required lockout kit may be installed in either terminal half. In this case, MTB/ATB lockout grant signal points are tied together through (normally-open-upon-alarm) redundant switchboard contacts within each terminal half so that lockout grant will be released automatically should a fault occur in either terminal half.

Refer to the documentation supplied with the lockout kit, and to the MTB/ATB wiring diagrams within the maintenance section, and install the lockout option equipment at this time.

3.8.7 Alarm Annunciator Connections

Several options are available for external alarm annunciator connections. The master terminal block (MTB) connection points and the corresponding alarm annunciation behavior are summarized by the following chart.

Annunciator Connection Points (on MTB)	Alarm Annunciator Behavior
17-22 and 17-D	Dry contact closure* upon major alarm provided that alarm panel's major alarm disable switch is in its "on" position; no closure if switch in its "disable" or "reset" position.
17-22 and 17-A	Dry contact closure* upon major alarm — independent of major alarm disable switch.
17-20 and 17-E	Dry contact closure* upon minor alarm — provided alarm panel's minor alarm switch is in its "on" position; no closure if switch in its "disable" or "reset" position.
17-20 and 17-21	Dry contact closure* upon minor alarm — independent of minor alarm disable switch.
17-W and 17-19	Relay contact closure* to system ground upon minor alarm.
*Dry reed type	Ratings (*resistive load only*): 10 VA max 100 V peak (ac or dc) max 0.5A max (switching) 1.5A max (carry only)

Referring to the chart, select the alarm annunciation behavior desired, and wire-wrap annunciator leads, according to the appropriate of MTB connector 17 pins A, D, E, W, 20, and 21. USE #24 AWG solid conductor wire.

3.9 FIELD-REQUIRED STRAPPING/ ADJUSTMENTS

In most cases, the printed circuit boards and units supplied with the paging terminal are supplied ready for operation. However, for a number of items, some field-performed strapping and/or adjustment may be required to tailor the item to the specific paging system configuration involved. Table 3-1 summarized this field-required strapping; while Table 3-2 presents those field-required adjustments which may be required.

Referring to these tables, to each kit's schematic diagram (or wiring diagram in the case of the MTB, ATB, or any of the system unit connector blocks), and to the appropriate theory of operation sections — perform the required strapping and/or adjustments at this time.

IMPORTANT

Not all of the strapping/adjustments prescribed here are necessarily applicable to all "Metro-Page" 10/100 equipment. Disregard those strapping/adjustment instructions associated with options which are not supplied. For example, LOCKOUT GRANT strapping within SP570306102 DFDD Output Control board is relevant only when the lockout option is used; "voice ASI compatibility" strapping is relevant only when a voice ASI option is used; etc.

Table 3-1. "Metro-Page" 10/100 Field-Required Strapping

KIT	FIELD-REQUIRED STRAPPING RELATED TO:
NLN8329A Master Terminal Block (MTB)	- Grounding of line out of service (LOS H) signal connection points associated with unused data set positions; ungronnding if associated with used position. - GO AHEAD TONE ALARM DISABLE H connection point (17-K) grounding or connecting to +5 V. - VALID TONE ALARM DISABLE H connection point (17-M) grounding or connecting to +5 V. - RINGBACK TONE ALARM DISABLE L connection point (17-L) grounding or connecting to +5 V. - Disconnection of VALID RECORDER CONTROL BIT (15-F) from +5 V if a valid recorder is used.
NLN8568A Auxiliary Terminal Block (ATB)	- Grounding of LOS H signal connection points associated with unused data set positions; ungrounding if associated with used positions. - -48 V and -130 V bus expansion (perform in odd-numbered ATB's only) - SYSTEM MAJOR ALARM L (18-Z) connection to SYS MAA 2 L (19-12) (in even-numbered ATB's); to (EXTENDED) SYSTEM MAJOR ALARM L (19-5) (in odd-numbered ATB's)
NLN8334B DC TCU	- Extension of the PAGE AUDIO BUS via insertion of the supplied Page Audio Jumper Card into connector slot 17 (perform only if slots 15 and 16 of the ATB connect to an NLN8507A Secondary TCU Rack).
* NLN8290A Input Unit Connector Block ** See Note 2, Fig. 2-48 in the Theory/Service manual.	- Final determination of vector address issued by the associated NLN8287A Interrupt Control Board (through strapping of VECTOR BIT 2 signal--pin B3D2--to either GND or +5 V).

Table 3-1. "Metro-Page" 10/100 Field-Required Strapping (Cont'd.)

KIT	FIELD-REQUIRED STRAPPING RELATED TO:
* SP570306104 Dual Function Decimal Digital (DFDD) Output Unit Connector Block ** See Note 1, Figure 2-50 for connections.	- Final determination of vector address issued by the associated NLN8287A Interrupt Control Board (through strapping of VECTOR BIT 2 signal--pin B3D2--to either GND or +5 V).
NLN8293ASP4 Dial Input Line Receiver ** See Note 3, Figure 2-16 for jumper options	- Sleeve lead signalling option
NLN8292A Dial Input Logic Board ** See Note 3, Figure 2-26 for jumper options	- When active SLEEVE condition occurs
NLN8328A Input Data Set Fuse Panel ** See Figure 2-6a and b for specific jumpering	- Impedance seen by input SLEEVE lead with "busy/operate" switch in "busy" (GND or 220 Ohms)
* NLN8286A Address Decoder Board ** See Table 1-5, page 1-14 for addresses and jumper selection	- Input unit response address
* NLN8287A Interrupt Control Board ** See Table 1-5, page 1-14 for input vectors and jumpering information. See Tables 1-6, page 1-14 or Table 1-14, page 1-35 for output unit vectors and jumpering information.	- Determination (to within two possible values) of vector address (associated with the peripheral using that particular board).
* NLN8314A Address Selector Board ** See Table 1-6, page 1-14 for DFDD or Table 1-14, page 1-35 for Binary-Address and jumper selection.	- Output Unit response address
SP570306102 DFDD Output Control ** See Note 4, Figure 2-12b for jumper selection	- Sense of LOCKOUT GRANT signal
NLN8299A Two-Tone Coder ** See Figure 2-17b for jumper selection	- Two-tone timing selection
* NLN8296A TCU Interface Board ** See Note 3, Figure 2-19b for jumper selection	- Change of board's input impedance due to inclusion of two-tone paging.
NLN8883A Binary Output Board ** See Note 3, Figure 2-20b for use of JU A or B	- Sense of DATA output signal (to be compatible with the type of paging transmitter used).
NLN8748A Binary TCU ** See Note 5, Figure 2-21b	- Group address response (JU: 0-15) - TCU alarm condition behavior (JU: D, E, F, G, L, M, N, P) - TCU lamp behavior (JU: A, H, J, K)
NLN8334ASP3 DC TCU ** See Note 4, Figure 2-22b	- Group address response (JU: 0-15) - Output telephone line configuration (JU: V, W, 23, 24, 25, 26, 27) - TCU alarm condition behavior (JU: A, B, C, D, E, F, G, L, M, N, P, Q) - TCU lamp behavior (JU: H, J, K) - PAGE AUDIO frequency response (JU: S, T) - DC Signaling parameters (JU: 17, 18, 20-22, 28, 29) - Voice ASI compatibility (JU: 30, 31)

Table 3-1. "Metro-Page" 10/100 Field-Required Strapping (Cont'd.)

KIT	FIELD-REQUIRED STRAPPING RELATED TO:
NLN8333ASP3 Tone TCU ** See Note 4, Figure 2-23b	- Group address response (JU: 0-15) - Output telephone line configuration (JU: U, V, W) - TCU alarm condition behavior (JU: A, B, C, D, E, F, G, L, M, N, P, Q) - PAGE AUDIO frequency response (JU: S, T) - Voice ASI compatibility (JU30)
NLN8352A Alarm Board "C" ** See Note 6, Figure 2-30b	- Alarms to be included in "major alarm" category (JU: 1, 2, 7) - Alarm panel lamp behavior (JU: 3, 4, 5, 6)
NLN8323A Dial Input Test Unit ** See Note 3, Figure 2-35b	- "Sleeve" lamp strapping compatible with sleeve lead signalling option associated with the dial input data set.

* Within originally supplied terminals, units designated with an asterisk (*) will be properly strapped at the factory. Field strapping involving these units may, however, be required at the time that field expansions are performed. See Tables 1-5, 1-6, and/or 1-14 within the theory of operation section of 68P81007C95 for a summary of the appropriate strapping required in the address decoder, address selector, and interrupt control boards--for any system size.

** References can be found in the Theory/Service Manual, 68P81007C95.

Table 3-2. "Metro-Page" 10/100 Field-Required Adjustments

KIT	FIELD-REQUIRED ADJUSTMENTS RELATED TO:
* NLN8296A TCU Interface Board ** See Note 4, Figure 2-19b for adjustment procedure.	DFDD output unit PAGE AUDIO signal level (into all of the DC/tone TCU's associated with the output unit containing the TCU interface board).
* NLN8883A Binary Output Board ** See Note 5, Figure 2-20b for adjustment procedure.	Binary output unit FSK DATA signal level (into all of the binary TCU's associated with the output unit containing the binary output board).
NLN8748A Binary TCU ** See Note 7, Figure 2-21b for adjustment procedure.	Signal level of FSK output amplitude (measured across TIP and RING leads of the TCU's output telephone line).
NLN8334ASP3 DC TCU ** See Note 5, Figure 2-22b for adjustment procedure or NLN8333ASP3 Tone TCU ** See Note 7, Figure 2-23b for adjustment procedure.	Signal level of page audio output amplitude (measured across TIP and RING leads of the TCU's output telephone line).
NHN6206A Accessory Drawer See Section 7, paragraph 3, b (3) in this manual for the adjustment procedure.	Power supply adjustment (perform at terminal installation; at time system expansions are done; and routinely every three months). See maintenance section of this manual for adjustment procedure.

* For each output unit used, perform these adjustments during initial terminal set up, as well as at any time that TCU's are added to the output unit.

** References can be found in the Theory/Service Manual, 68P81007C95.

4. PREOPERATIONAL TESTING/CHECKOUT PROCEDURES

The following pre-operational checkout procedures will verify that the paging terminal is ready for operation. The parts of the procedures applicable to the paging terminal supplied should be performed after all terminal interconnections/preparations described in the previous section 3 have been correctly carried out.

NOTE

The procedures described here may also be effectively used after the terminal is already operational (i.e. "on-line") in order to systematically check for proper operation of specific terminal subsystems.

4.1 POWER TURN ON

Step 1. Within each terminal (terminal-half--for redundant configurations), turn the following to their "on" positions:

- (where applicable) disc ac junction box switch to "on'."
- (where applicable) valid/invalid recorder switch(es) to "on."
- (where applicable) -48 V control switch(es) to "on."
- (where applicable) -130 V control switch(es) to "on".
- Computer and accessory drawer circuit breakers to "on"; "local-remote" switches to "remote."
- +5 V and +12 V power switches on all ac distribution panels to "on."

Step 2. Within each terminal/terminal-half, turn the local teletypewriter switch to the LINE position and place the "normal-maintenance" switch on all power control boards (MTB, ATB-2, -4,...slot 19) into the "maintenance" position (to inhibit system major alarms during initial checkout procedures).

Step 3. Apply input power by turning on the main power breakers (middle of panel) on each ac distribution panel.

IMPORTANT

Check at this time to ensure that no overheating is occurring. Should unusual heating be evidenced, immediately switch off the main power breakers and recheck all previous interconnections/preparations.

4.2 CHECKOUT OF DEC EQUIPMENT

The following sequence of diagnostic routines will checkout all of the DEC equipment in the system. It is imperative that the equipment pass all of the listed routines before continuing to the next section. Each of the routines listed should be run for a minimum of five passes. For each routine listed refer to the corresponding DEC listing for proper setup and operation. Paper-tape systems will load the routines through the PC11 using absolute loader (see Operating Manual, Section III PDS-BSL and PDS-ABL for loading procedures). Full magtape systems will load routines off of the diagnostic tape following the procedure described in the XXDP manual supplied with the diagnostic tapes (see section 7.6 of this manual). The routines are:

- 11 Family Instruction Exercise
- T14 Trap Test
- MOS/CORE 0-124k Exer
- KL11/DL11 Teletype Tests
- Power Fail
- DR11C Device Register Test

On this test remove link cables and install test cable between connectors 1 and 2. The cable should be installed such that pin A of connector 1 connects to pin VV of connector 2. Once the diagnostic routine is loaded, refer to the DEC listings and specify device address to be 177520_8 and vector address to be 110_8.

- DDC Disk Diagnostic, Run Tests 2, 3, 4, 5, 6, and 7

Run the following diagnostics as required by peripheral equipment:

- PC11 High Speed Reader/Punch Test
- DC11 Off Line Test. This test should run with the modem cable disconnected from the modem and a turn around connector installed in its place. If this is not available, one can be made by wiring a 25 pin cinch female connector as follows: Pin 20 to 8 to 5; 22 to 4; 2 to 3; 11 to 12. Once the diagnostic is loaded, refer to the DEC listings and specify device address to be $1740XX_8$ and vector address to be $3XX_8$ where XX is

  00_8 for unit 1
  10_8 for unit 2
  20_8 for unit 3
  etc.

- Magtape Unit; run the following three tests in sequence:

IMPORTANT

After loading the diagnostic from the source tape, dismount the source tape and mount a scratch tape before starting the diagnostic, as each of the routines will write to the tape unit.

TMA-11, TMB-11 Instruction Test
TM-11 Data Reliability (9 track)
TMA-11, TMB-11 Drive Function Timer

After the above diagnostics have been run, load the DEC/X11 runtime exerciser (see section 7.6 of this manual) for a minimum of four hours and preferably a full day. This should be run with exercise routines selected for disk, processor, line clock, redundancy link (DR11C), magtape if available, and remote terminals (DC11) if available. The setup for DR11C and DC11 is as described in individual diagnostic routines above. The whole of this section should be done for both halves of the terminal. When complete, reconnect link cables (DR11C) and model cables, before proceding to the next section. See section 3, paragraph 6, e, of this manual for reconnection procedure.

4.3 SOFTWARE INITIALIZATION

(Refer to section II of the Operating Manual supplied)

Step 1. Perform the software initialization steps required to "bringup" the terminal; however, do not yet establish the subscriber list.

Step 2. Set all software timers to their required values for your application.

Step 3. Once software is initialized and the program is running, verify that the RUN lamp is illuminated on the terminal's CPU (on each terminal-half's CPU -- for redundant configurations).

4.4 VALID/INVALID RECORDED MESSAGE SET UP

(where applicable)

Refer to the appropriate recorder manufacturer's manual.

4.5 INPUT TEST PANEL SET UP/CHECK

At the input test panel of the terminal (of each terminal half — for redundant terminal configurations) set up the correct levels for the various system audio signals by adjusting the appropriate potentiometers while monitoring the test panel's Vu meter -- as per the following chart.

SIGNAL	AUDIO SWITCH SETTING	POTENTIOMETER	REQUIRED Vu METER LEVEL (dBm)
continuous (go-ahead) tone	ans	ans (pot 1)	-7
ringback tone	rng	rng (pot 2)	-7
invalid audio	invld	inv (pot 3)	-7
valid audio	vld	vld (pot 4)	-7
option (typically ASI audio in)	opt	opt (pot 5)	-7

4.6 ALARM PANEL CHECKOUT

Perform the alarm panel check per Table 4-1.

NOTE

For redundant terminal configurations, the checkout described by Table 4-1 should be done TWICE -- once for each terminal half. At the beginning of each checkout, ensure that all alarm panel "on/disable/reset" switches are in their "on" positions. Where external alarm annunciator connections have been made, behavior appropriate to the annunciation options chosen (see section 3, paragraph 8, g.) should also be observed.

CAUTION

If this checkout is performed on an already working (i.e. "on-line") system, first "busy-out" the terminal/terminal-half by placing all "busy-operate" switches on all input data set fuse panels in their "busy" positions. However, to insure that no calls in progress are interrupted, observe each data set's "busy" lamp and move the associated "busy-operate" switch to "busy" ONLY when the data set's "busy" lamp extinguishes.

Table 4-1. Alarm Panel Checkout

ITEM NO.	FUNCTION/MECHANISM TESTED	PROCEDURE	INDICATION
1	Lamp Test	Depress lamp test pushbutton	Following lamps light: "fuse alarm" "+5V" "cpu" "+12V" "major alarm" "los" "fse" "minor alarm" NOTE Other lamps may also light depending on the specific system configuration.
2	+5V Fail	In turn, switch off +5V at the appropriate AC distribution panel +5V outlet for each +5V system power supply (insuring that +5V remains on in all system power supplies other than the one under immediate test). CAUTION After testing, insure that all +5V supplies are turned on.	"+5V" and "major alarm" lamps light. Major alarm contact operation (per Section 4.6).
3	+12V Fail	In turn, switch off +12V at the appropriate AC distribution panel +12V outlet for each +12V system power supply (insuring that +12V remains on in all system power supplies other than the one under immediate test). CAUTION After testing insure that all +12V supplies are turned on.	"+12V" lamp lights (for first system power supply); "+12V" and "major alarm" lamps light (for all other system power supplies). Major alarm contact operation.
4	-48 Fail	In turn, switch off each -48V power source (insuring that -48V remains applied from all -48V power sources other than the one under immediate test). NOTE When -48V power is externally supplied use the appropriate NLN8767A Control Switch for on/off control.	"-48V" and "major alarm" lamps light. Major alarm contact operation.
5	-130V Fail 0	In turn, switch off each -130V power source (insuring that -130V remains applied from all other -130V power sources other than the one under immediate test). NOTE When -130V power is externally supplied, use the appropriate NLN8767A Control Switch for on/off control.	"-130V" and "major alarm" lamps light. Major alarm contact operation.
6	Processor Fail	Halt the processor by depressing its HALT/ENABLE switch. CAUTION After testing, restart the computer by carefully following the system restart procedures described in Section II (para. 4) of the operating manual.	"cpu" and "major alarm" lamps light after approximately 1.5 seconds. Major alarm contact operation.
7	Transmitter Group Fail	Unplug all TCU's from their TCU rack connectors (disconnect-only is sufficient--it is not necessary to completely remove the TCU's from their slots). CAUTION After testing, firmly re-seat all TCU's into their respective connectors.	"tgf" lamp (in "major" section of panel) and "major alarm" lamps light--if tgf alarm is defined as major; "tgf" lamp (in "minor" section of panel) and "minor" alarm lamps light if tgf alarm defined as minor. Major/minor alarm contact operation.
8	Synthesizer Fail (Where terminal/terminal-half includes one or more non-binary output units)	Temporarily jumper MTB 17-13 (SYN FAIL) to MTB 17-19 (GND). CAUTION Remove jumper after testing.	"syn" and "major alarm" lamps light. Major alarm contact operation.

Table 4-1. Alarm Panel Checkout (Cont'd.)

ITEM NO.	FUNCTION/MECHANISM TESTED		PROCEDURE	INDICATION
9	Minor TCU Alarm		Temporarily jumper MTB 10-19 (TCU ALARM L) to MTB 10-2 (GND). **CAUTION** Remove jumper after testing.	"tcu" and "minor alarm" lamps light. Minor alarm contact operation (per Section 4.6)
10	Co-ahead Tone Fail (Where terminal/terminal half includes one or more end-to-end type data sets)		Temporarily unplug the NLN8324A Tone Oscillator (slot 1 of the NLN8321A Basic Test Unit's card rack). **CAUTION** After testing, firmly re-seat this card into its connector.	"ans" and "minor alarm" lamps light. Minor alarm contact operation.
11	Valid Audio Fail	(Where terminal/terminal-half uses interrupted valid tone option)		"vld" and "minor alarm" lamps light. Minor alarm contact operation.
		(Where terminal/terminal-half uses recorded valid message option)	Temporarily turn off valid message recorder. **CAUTION** After testing, restart recorder.	
12	Ringback Tone Fail (Where terminal/terminal half includes one or more dial-input type data sets)		Temporarily unplug the NLN8320A Ringback Generator (slot 4 of the test unit's card rack). **CAUTION** After testing, firmly re-seat this card into its connector.	"rng" and "minor alarm" lamps light. Minor alarm contact operation.
13	Invalid Audio Fail	(Where terminal/terminal-half uses recorded invalid message option)	Temporarily switch off the invalid message recorder. **CAUTION** After testing, restart recorder.	"inv" and "minor alarm" lamps light. Minor alarm contact operation.
14	Voice ASI Fail (Where recorded voice automatic station identification option is used)		Temporarily switch off the ASI recorder. **CAUTION** After testing, restart recorder.	"asi" and "minor alarm" lamps light. Minor alarm contact operation.
15	Fuse Alarms		In turn, place a blown "grasshopper" fuse in the +5V fuseholder and the +12V fuseholder associated with: - each data set (fuseholders on fuse panel immediately below the data set) - each TCU (fuseholders located on TCU module, itself) **CAUTION** After testing, replace good fuses in all fuseholders.	"fuse" and "fuse alarm" lamps light.
16	(major) "on/disable/reset" switch		Switch in "on" (existing condition at start of checkout)	Continuity between external (switched-normally-closed-on major-alarm) annunciator points MTB 17-22 and MTB 17-D upon occurrence of any of the above major-designated alarms. (check where applicable.)
			Move switch to "disable"	- (major) "disable" lamp lights - Non-continuity now in above-referenced external switched major annunciator points. (check where applicable.)
			Place the "normal-maintenance" switch on all power control boards (MTB, ATB-2, ATB-4, ... slot 19) into "normal" position and move the (major) "on/disable/reset" switch to "reset position.	- "major alarm" lamp lights - Disconnect of all +12V supplying the terminal/terminal-half's data sets. (Verify by measuring between MTB 19-F (+12V SWITCHED) and MTB 19-Z (GND) of each MTB and ATB.)

Table 4-1. Alarm Panel Checkout (Cont'd.)

ITEM NO.	FUNCTION/MECHANISM TESTED	PROCEDURE	INDICATION
16 (cont'd)	(major) "on/disable/ reset switch	NOTE After testing, return the (major) "on/disable/ reset" switch to "on", and all "maintenance-normal" switches to "maintenance" position.	- (Redundant terminal configuarations) redundant switchboard relays of this terminal half de-energize. (May be audibly/ visually verified; this behavior should actually occur for any system major alarm.) NOTE The "reset position of the major "on/disable/reset" switch induces an artificial system major alarm (through Alarm Board "B"1) to allow the terminal operator to manually originate switchover of that terminal half's redundant switch-board relays within redundant terminal configurations.
17	(minor) "on/disable/reset" switch	Switch in "on" (existing condition at start of checkout)	Continuity between external (switched-normally-closed-on-minor-alarm) annunciator points MTB 17-20 and MTB 17-E upon occurrence of any of the above minor-designated alarms. (Check where applicable.)
		Move switch to "disable" NOTE Return switch to "on" after this check--the minor "on/disable/reset" switch's "reset" position is not used in standard terminal configurations.	- (minor) "disabled" lamp lights - Non-continuity now in above-referenced external switched minor annunciator points. (Check where applicable).

4.7 DIAL-INPUT LINE INTERFACE SET CHECKOUT (where applicable)

Perform the dial input line interface set checkout per Table 4-2 for each dial-input line interface set (dial-input data set plus associated input register) used in the terminal/terminal-half.

NOTE

For redundant terminal configurations, the checkout described by Table 4-2 should be done TWICE--once for each terminal half.

Table 4-2. Dial Input Line Interface Set Checkout

ITEM NO.	FUNCTION/MECHANISM TESTED	PROCEDURE	INDICATION
1	------- (Preparations for Testing)	a. Place the "busy-operate" switch associated with the dial input data set under test to its "busy" position to insure that the associated input line will apply busy condition to the telephone company central office while testing is being performed. IMPORTANT If this checkout is being performed on an already working (i.e. "on-line") system, wait until the "busy" lamp (on the data set to be tested) extinguishes before "busying-out" the line. This will insure that no call in progress is interrupted. Also, place all "normal-maintenance" switches into "maintenance" position. b. Insert an NKN6180A Data Set Patch Cord first into jack 1 on the dial input test unit and then into jack 1 on the dial input data set under test. If SLEEVE lead supervision is used, insert a second NKN6180A patch cord first into jack 2 on the test unit and then into jack 2 on the data set under test. CAUTION Live -48V is present on the dial-input data set side; always insert patch cords into the test unit side first. c. Set the rotary ("audio") switch on the test panel to position 2. (This position monitors signals supplied by the data set under test to its associated telephone line TIP and RING leads.) d. Turn test panel's volume control to approximately mid-range.	---------
2	Invalid Call Simulation	a. Identify a numoer within the subscriber list which has not been validated. (Should no such number exist, arbitrarily choose the first entry of the list and invalidate it.) See Section II of the operating manual for specific instructions concerning subscriber number validation/invalidation. IMPORTANT When this checkout is initially done, any arbitrary number of the subscriber list will be invalid at this time as the subscriber list will not have yet been established.	----------
		b. Set the "seize-off" switch on the dial-input test unit to "seize" position to apply loop resistance across TIP-RING (thereby simulating line seizure by the central office).	- Dial input test unit's "t/r normal" lamp lights (to indicate that data set has correctly put TIP at GND; RING at -48V) - Data set's "busy" lamp lights (to indicate that the computer has correctly responded to the initial servicing request) - (For SLEEVE lead supervision with SLEEVE active during call) dial input test unit's "sleeve" lamp lights
		c. On the rotary dial of the test unit, dial in the digits of the invalid number identified in step a. above.	- Dialing signals (pulse clicks) should be heard from the test panel's loudspeaker. - As the dial returns to its rest position after each digit, the "data" lamps on the data set should total up and momentarily(for about 300 msec) indicate the binary coded decimal (BCD) equivalent of the number of dial pulses entered for that digit. (Per the following chart:)

Table 4-2. Dial Input Line Interface Set Checkout (Cont'd.)

<table>
<tr><th>ITEM NO.</th><th>FUNCTION/MECHANISM TESTED</th><th>PROCEDURE</th><th>INDICATION</th></tr>
<tr><td>2 (cont'd)</td><td>Invalid Call Simulation</td><td>IMPORTANT
Correct system response requires the following:
- first digit entered within a definite (software-specified) time after line seizure (normally 5 sec)
- at least 160 msec between digits
- last digit entered within a definite (software-specified) period (normally 15 sec) from the time the first digit was entered</td><td>
<table>
<tr><th rowspan="2">DIGIT DIALED</th><th colspan="4">DATA SET LAMP DISPLAY</th></tr>
<tr><th>DATA 1</th><th>DATA 2</th><th>DATA 3</th><th>DATA 4</th></tr>
<tr><td>1</td><td>ON</td><td>OFF</td><td>OFF</td><td>OFF</td></tr>
<tr><td>2</td><td>OFF</td><td>ON</td><td>OFF</td><td>OFF</td></tr>
<tr><td>3</td><td>ON</td><td>ON</td><td>OFF</td><td>OFF</td></tr>
<tr><td>4</td><td>OFF</td><td>OFF</td><td>ON</td><td>OFF</td></tr>
<tr><td>5</td><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td></tr>
<tr><td>6</td><td>OFF</td><td>ON</td><td>ON</td><td>OFF</td></tr>
<tr><td>7</td><td>ON</td><td>ON</td><td>ON</td><td>OFF</td></tr>
<tr><td>8</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td></tr>
<tr><td>9</td><td>ON</td><td>OFF</td><td>OFF</td><td>ON</td></tr>
<tr><td>10</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td></tr>
</table>
- Approximately 0.5 seconds after the last entered digit, the ringback tone should be heard on the loudspeaker and should last for the duration of the software-determined ringback period.
- Immediately upon end of ringback tone, invalid audio should begin and be heard for the duration of the software-determined invalid audio timing period. (Invalid audio will be either a "wailing" tone or a recorded invalid message--depending on the option supplied.)
- Immediately after the end of invalid audio, "t/r reverse" lamp should light, and "t/r normal" lamp should extinguish for approximately 0.5 sec.
NOTE
This momentary reversal is insufficient to initiate billing, but is sufficient to serve as a line disconnect signal to the central office (for use when SLEEVE lead supervision is not used).
- (for SLEEVE supervision with SLEEVE active during call) Test unit's "sleeve" lamp extinguishes</td></tr>
<tr><td>3</td><td>Valid Call Simulation</td><td>a. Validate the number in the subscriber list. (See section II of the operating manual.)</td><td>--------</td></tr>
<tr><td></td><td></td><td>b. Set the "seize-off" switch on the dial input test unit to "seize."</td><td>- Dial input test unit's "t/r normal" lamp lights
- Data set's "busy" lamp lights
- (For SLEEVE lead supervision with SLEEVE active during call) test unit's "sleeve" lamp lights</td></tr>
<tr><td></td><td></td><td>c. Dial in "0000" on the rotary dial of the dial input test unit.</td><td>- "data 2" and "data 4" lamps on the data set should momentarily light after each "0" is dialed to indicate that 10 dial pulses were entered.
- Approximately 0.5 sec after the last entered digit:
(1) "t/r reverse" lamp should light and "t/r normal" lamp should extinguish.
(2) Ringback tone should begin and be heard for the duration of the software-determined ringback period.
- Immediately after the end of ringback tone, valid audio should begin and be heard for the duration of the software-determined valid audio period. (Valid audio will be either an interrupted 2025 Hz tone or a recorded valid message--depending on the option supplied.)
- Immediately after the end of valid audio:
(1) "t/r reverse" lamp should extinguish and "t/r normal" lamp should re-light (to indicate the end of the billing period).
(2) Data set's "busy" lamp should extinguish.</td></tr>
</table>

Table 4-2. Dial Input Line Interface Set Checkout (Cont'd.)

<table>
<tr><th>ITEM NO.</th><th>FUNCTION/MECHANISM TESTED</th><th>PROCEDURE</th><th>INDICATION</th></tr>
<tr><td>3 (cont'd)</td><td>Valid Call Simulation</td><td></td><td>- (For SLEEVE lead supervision with SLEEVE active during call) test unit's "sleeve" lamp extinguishes.</td></tr>
<tr><td>4</td><td>Input Register Write/Read</td><td>a. Halt the processor by depressing its HALT /ENABLE switch.

b. Using the computer switch register toggle arms, load the processor's address register with the input register address corresponding to the line interface set under test--as per the following chart:

<table>
<tr><th>Register</th><th>Address (Octal)</th></tr>
<tr><td>Input register of first LIS within input unit
Input register of second LIS within input unit
Input register of third LIS within input unit
Input register of fourth LIS within input unit
Input register of fifth LIS within input unit
Input register of sixth LIS within input unit
Input register of seventh LIS within input unit
Input register of eighth LIS within input unit</td><td>170mn0
170mn2
170mn4
170mn6
170m(n+1)0
170m(n+1)2
170m(n+1)4
170m(n+1)6

where m, n given as follows:
<table>
<tr><th>input unit</th><th>m</th><th>n</th></tr>
<tr><td>first (DS 1-8)</td><td>0</td><td>0</td></tr>
<tr><td>second (DS 9-16)</td><td>0</td><td>2</td></tr>
<tr><td>third (DS 17-24)</td><td>0</td><td>4</td></tr>
<tr><td>fourth (DS 25-32)</td><td>0</td><td>6</td></tr>
<tr><td>fifth (DS 33-40)</td><td>1</td><td>0</td></tr>
<tr><td>sixth (DS 41-48)
.
.
etc.</td><td>1
.
.
etc.</td><td>2
.
.
etc.</td></tr>
</table></td></tr>
</table>

NOTE

See PDS-BSL in Section III of the operating manual for specific details of address loading.

c. Set the switch register toggle arms to:
<table>
<tr><td>TOGGLE ARM NO:</td><td>8</td><td>0-7, 9-15</td></tr>
<tr><td>POSITION:</td><td>1</td><td>0</td></tr>
</table>
("1" = up; "0" = down)

and then momentarily raise the DEPosit switch to deposit a "high" LOS bit (simulating an out of service condition) into the input register of the line interface set under test.

d. Depress the EXAMine switch once. (This maintains the originally entered input register address within the processor's address register, and allows deposit of additional information at that address.) Set the switch register toggle arms to:
<table>
<tr><td>TOGGLE ARM NO.:</td><td>8</td><td>9</td><td>6</td><td>0-5, 7, 10-15</td></tr>
<tr><td>POSITION:</td><td>0</td><td>1</td><td>1</td><td>0</td></tr>
</table>
("1" = up; "0" = down)

and momentarily raise the DEPosit switch to deposit a low LOS bit (simulating removal of the out of service condition) into the input register of the line interface set under test.</td><td>- "out of service" lamp on data set associated with the addressed input register should light

- Alarm panel's "los" and "minor alarm" lamps should light.

- "out of service" lamp on the data set associated with the addressed input register should extinguish.

- (For systems with older alarm panels having latching alarms) alarm panel's "los" and "minor alarm" lamps can be extinguished by momentarily placing the panel's minor "on/disable/reset" switch into "reset" position.

- (For systems with alarm panels having non-latching alarms) alarm panel's "los" and "minor alarm" lamps should extinguish.</td></tr>
</table>

Table 4-2. Dial Input Line Interface Set Checkout (Cont'd.)

ITEM NO.	FUNCTION/MECHANISM TESTED	PROCEDURE	INDICATION
4 (cont'd)	Input Register Read/Write	NOTE High bits 9 and 6 inserted at this time prepare the line interface set for interrupts and reading by the processor once normal operation is resumed.	
5	------ (Preparation for Normal Operation)	a. Remove the data set patch cord(s) (always unplugging from the data set side first). b. Return the "busy-operate" switch associated with the line interface set under test to its "operate" position. c. Restart the processor per section II (para 4) of the operating manual. d. If testing was done on an already "on-line" system, return all "maintenance-normal" switches to "normal and re-establish the appropriate valid/invalid conditions for any subscriber list numbers changed for testing. If this is the initial pre-operational test, return to the "no-number-validated" condition.	

4.8 END-TO-END LINE INTERFACE SET CHECKOUT (where applicable)

Perform the end-to-end line interface set checkout per Table 4-3 for each end-to-end line interface set (end-to-end data set plus associated input register) used in the terminal/terminal-half.

NOTE

For redundant terminal configurations, the checkout described by Table 4-3 should be done TWICE -- once for each terminal half.

Table 4-3. "Metro-Page" 10/100 End-to-End Line Interface Set Checkout

ITEM NO.	FUNCTION/MECHANISM TESTED	PROCEDURE	INDICATION
1	--- (Preparations for Testing)	a. Place the "busy-operate" switch associated with the end-to-end data set under test to its "busy" position to insure that the associated input line will apply busy condition to the telephone company central office while testing is being performed. IMPORTANT If this checkout is being performed on an already working (i.e. "on-line") system, wait until the "busy" lamp (on the data set to be tested) extinguishes before "busying-out" the line. This will insure that no call in progress is interrupted. Also, place all "normal-maintenance" switches into "Maintenance" position. If the already "on-line" system is a redundant configuration, additionally place the "maintenance-normal" switch (MTB/ATB slot 19 connector cards) in "Maintenance" position to prevent disconnect of +12V (SWITCHED) voltage to the data sets. b. Insert an NKN6180A Data Set Patch Cord first into jack 1 on the end-to-end data set under test and then into jack 1 on the end-to-end input test set. CAUTION 100 Vrms ringing voltage is generated by the end-to-end input test unit whenever the "ring" pushbutton is depressed. For this reason, the patch cord should always be inserted into the test unit side last. c. Set the rotary ("audio") switch on the test panel to position 1. (This position monitors signals supplied by the data set under test to its associated telephone line TIP and RING leads.) Set switch S1 (under the keypad) to position 3 (-26 dBm) to simulate the lowest level signal expected on the input line. d. Turn test panel's volume control to approximately mid-range.	---
2	Invalid Call Simulation	a. Identify a number within the subscriber list which has not been validated. (Should no such number exist, arbitrarily choose the first entry of the list and invalidate it.) See section II of the operating manual for specific instructions concerning subscriber number validation/invalidation.	---

Table 4-3. "Metro-Page" 10/100 End-to-End Line Interface Set Checkout (Cont'd.)

<table>
<tr><th>ITEM NO.</th><th>FUNCTION/MECHANISM TESTED</th><th>PROCEDURE</th><th>INDICATION</th></tr>
<tr><td>2
(cont'd)</td><td></td><td>IMPORTANT
When this checkout is initially done, any arbitrary number of the subscriber list will be invalid at this time as the subscriber list will not have yet been established.</td><td>---</td></tr>
<tr><td></td><td></td><td>b. Momentarily depress the "ring" pushbutton on the test unit to apply ringing voltage to the data set.
NOTE
Ringing voltage must be present for at least 250 msec for the data set to respond.</td><td>- Data set's "busy" lamp lights (to indicate that the computer has correctly responded to the initial servicing request and has initiated an approximately 4.5 sec billing period. At the end of the billing period 2025 Hz continuous go-ahead tone should be heard (for about 0.5 sec) from the test panel's loudspeaker.</td></tr>
<tr><td></td><td></td><td>c. (After go-ahead tone is given) enter (via the keypad of the test unit) the digits of the invalid number identified in step a. above.
IMPORTANT
Correct system response requires the following:
- first digit entered within a definite (software-specified) time after the end of the go-ahead tone (nominally 5 sec.)
- each digit continuously present for at least 50 msec.
- at least 44 msec between digits
- last digit entered within a definite (software-specified) period (nominally 15 sec) from the time the first digit was entered or (for "Metro-Page" 100 terminals, only) from the time the correction symbol (#) was depressed.</td><td>- Dialing signals (combination of two tones per digit) should be heard from the test panel's loudspeaker.
- While each digit is being entered, the "data" lamps on the data set should indicate the encoded combination equivalent of the two tones being entered for that digit. (Per the following chart:)
<table><tr><th rowspan="2">DIGIT</th><th colspan="2">TONES GENERATED (Hz)</th><th colspan="4">DATA SET DISPLAY</th></tr><tr><th>DATA 1</th><th>DATA 2</th><th>DATA 3</th><th>DATA 4</th></tr><tr><td>1</td><td>697</td><td>1209</td><td>ON</td><td>OFF</td><td>ON</td><td>OFF</td></tr><tr><td>2</td><td>697</td><td>1336</td><td>ON</td><td>OFF</td><td>OFF</td><td>ON</td></tr><tr><td>3</td><td>697</td><td>1477</td><td>ON</td><td>OFF</td><td>ON</td><td>ON</td></tr><tr><td>4</td><td>770</td><td>1209</td><td>OFF</td><td>ON</td><td>ON</td><td>OFF</td></tr><tr><td>5</td><td>770</td><td>1336</td><td>OFF</td><td>ON</td><td>OFF</td><td>ON</td></tr><tr><td>6</td><td>770</td><td>1477</td><td>OFF</td><td>ON</td><td>ON</td><td>ON</td></tr><tr><td>7</td><td>852</td><td>1209</td><td>ON</td><td>ON</td><td>ON</td><td>OFF</td></tr><tr><td>8</td><td>852</td><td>1336</td><td>ON</td><td>ON</td><td>OFF</td><td>ON</td></tr><tr><td>9</td><td>852</td><td>1477</td><td>ON</td><td>ON</td><td>ON</td><td>ON</td></tr><tr><td>0</td><td>941</td><td>1336</td><td>OFF</td><td>OFF</td><td>OFF</td><td>ON</td></tr><tr><td>*</td><td>941</td><td>1209</td><td>OFF</td><td>OFF</td><td>ON</td><td>OFF</td></tr><tr><td>#</td><td>941</td><td>1477</td><td>OFF</td><td>OFF</td><td>ON</td><td>ON</td></tr></table>- Immediately after the last digit is entered, invalid audio should begin and be heard for the duration of the software-determined invalid audio timing period. (Invalid audio will be either a "wailing" tone or a recorded invalid message--depending on the option supplied.)
- Upon end of invalid audio timing period:
*(For Standard 100 Terminals) a second go-ahead tone is given (to normally prompt the caller to re-enter a valid number). For purposes of this checkout, simply wait without entering a new number. The "busy" lamp should extinguish in approximately 5 sec (via timeout of the software dial-start timer).
*(For Standard 10 and Standard 10-Redundant Terminals) data set's "busy" lamp should immediately extinguish.</td></tr>
<tr><td>3</td><td>Valid Call Simulation</td><td>a. Identify/validate three convenient numbers of the subscriber list so that all digits from 0 to 9 are included. (See section II of the operating manual.)</td><td>---</td></tr>
<tr><td></td><td></td><td>b. Momentarily depress the "ring" pushbutton on the test unit to apply ringing voltage to the data set.</td><td>- Data set's "busy" lamp lights (to indicate that the computer has correctly responded to the initial servicing request and has initiated an approximately 4.5 sec billing).
- (At the end of the billing period) 2025 Hz continuous go-ahead tone should be heard (for about 0.5 sec) from the test panel's loudspeaker.</td></tr>
<tr><td></td><td></td><td>c. (After go-ahead tone is given) enter the digits of the first valid paging number identified in a. above via the keypad of the test unit.</td><td>- Dialing signals (combination of two tones per digit) should be heard from the test panel's loudspeaker.
- While each digit is being entered, the "data" lamps on the data set should indicate the encoded combination equivalent of the two tones being entered for that digit. (Per the chart in item 2c.)</td></tr>
</table>

Table 4-3. "Metro-Page" 10/100 End-to-End Line Interface Set Checkout (Cont'd.)

<table>
<tr><th>ITEM NO.</th><th>FUNCTION/MECHANISM TESTED</th><th>PROCEDURE</th><th>INDICATION</th></tr>
<tr><td>3 (cont'd)</td><td></td><td></td><td>- Immediately after the last digit is entered, valid audio should begin and be heard for the duration of the software-determined valid audio timing period. (Valid audio will be either an interrupted 2025 Hz tone or a recorded valid message--depending on the option supplied.)
- Data set's "busy" lamp extinguishes upon completion of valid audio timing period.</td></tr>
<tr><td></td><td></td><td>d. Repeat steps b. and c. for each of the remaining two valid numbers identified in a.</td><td>Same indications as with b. and c. above--should be given.</td></tr>
<tr><td>4</td><td>Input Register Write/Read</td><td>a. Halt the processor by depressing its HALT/ENABLE switch.
b. Using the computer switch register toggle arms, load the processor's address register with the input register address corresponding to the line interface set under test--as per the chart in Table II-4 item 4b.
NOTE
See PDS-BSL in section III of the operating manual for specific details of address loading.
c. Set the switch register toggle arms to:
<table><tr><td>TOGGLE ARM NO:</td><td>8</td><td>0-7, 9-15</td></tr><tr><td>POSITION:</td><td>1</td><td>0</td></tr></table>("1" = up; "0" = down)
and then momentarily raise the DEPosit switch to deposit a "high" LOS bit (simulating an out of service condition) into the input register of the line interface set under test.
d. Depress the EXAMine switch once. (This maintains the originally entered input register address within the processor's address register, and allows deposit of additional information at that address.) Set the switch register toggle arms to:
<table><tr><td>TOGGLE ARM NO.:</td><td>8</td><td>9</td><td>6</td><td>0-5, 7, 10-15</td></tr><tr><td>POSITION:</td><td>0</td><td>1</td><td>1</td><td>0</td></tr></table>("1" = up; "0" = down)
and momentarily raise the DEPosit switch to deposit a low LOS bit (simulating removal of the out of service condition) into the input register of the line interface set under test.
NOTE
High bits 9 and 6 inserted at this time prepare the line interface set for interrupts and reading by the processor once normal operation is resumed.</td><td>- "out of service" lamp on data set associated with the addressed input register should light
- Alarm panel's "los" and "minor alarm" lamps should light
- "out of service" lamp on the data set associated with the addressed input register should extinguish.
- (For systems with older alarm panels having latching alarms) alarm panel's "los" and "minor alarm" lamps can be extinguished by momentarily placing the panel's minor "on/disable/reset" switch into "reset" position.
- (For systems with alarm panels having non-latching alarms) alarm panel's "los" and "minor alarm" lamps should extinguish.</td></tr>
<tr><td>5</td><td>---
(Preparation for Normal Operation)</td><td>a. Remove the data set patch cord (always unplugging from the end-to-end input test set side first).
b. Return the "busy-operate" switch associated with the line interface set under test to its "operate" position.
c. Restart the processor per section II (para. 4) of the operating manual.
d. (If testing was done on an already "on-line" system) re-establish the appropriate valid/invalid conditions for any subscriber list numbers changed for testing and restore all "maintenance-normal" switches to "normal."</td><td></td></tr>
</table>

4.9 DUAL FUNCTION DECIMAL DIGITAL (DFDD) OUTPUT PATH CHECKOUT (where applicable)

Perform the checkout prescribed by Table 4-4 for each DFDD output path used in the terminal/terminal-half. (DFDD output path = DFDD output unit plus its associated set of up to 24 total transmitter control units.)

NOTE

DC or tone type transmitter control units (TCU's) are used with DFDD output units. For redundant terminal configurations, the checkout described by Table 4-4 should be done TWICE -- once for each terminal half.

Table 4-4. "Metro-Page" 10/100 Dual Function Decimal Digital (DFDD) Output Path Checkout

<table>
<tr><th>ITEM NO.</th><th>FUNCTION/MECHANISM TESTED</th><th>PROCEDURE</th><th>INDICATION</th></tr>
<tr><td>1</td><td>---
(Preparations for Testing)</td><td>a. On the terminal/terminal-half to be tested, "busy-out" all input lines via the fuse panel "busy-operate" switches.

CAUTION

If checkout is being performed on an already working (i.e. "on-line") system, wait until a data set's "busy" lamp extinguishes before placing its "busy-operate switch to "busy." (This will insure that no calls in progress are interrupted.)

b. (Perform this step only for redundant terminal configurations already "on-line" and working; for all other configurations, proceed immediately to step c.)

(1) (If a Standard 10-Redundant Terminal) Place the terminal-half being tested into its "standalone" mode. (See FDS-CP in Section IV of the "Metro-Page" Standard 10-Redundant Operating Manual)

(2) Place the major "on/disable/reset" switch of the alarm panel in the terminal half being tested into its "reset" position. This will cause activation of the redundant switchboard relays of that terminal half thereby allowing any standby input telephone lines to connect to the opposite terminal half. It will also open up the output busy interlock to permit this terminal half to page independently.

c. Select the "ou" position on the test panel's audio switch which corresponds to the specific output unit position associated with the DFDD output path being checked. (This allows monitoring of the page audio signal provided by the DFDD output unit under test.)

d. Turn the test panel's volume control to about its mid-clockwise position.</td><td>---</td></tr>
<tr><td>2</td><td>Output Unit Single Tone Generation

IMPORTANT
The procedure given here describes how to generate a constant tone 3 (1023 Hz) from the first tone slot of a DFDD page. The procedure can be used, however, in conjunction with the DFDD Output Register Bit Assignments Chart; the DFDD, two-tone, and subaudible--ROM Coding Charts (all in section 1 of manual 68P81007C95) to selectively place any DFDD tone into any of the five tone slots associated with a DFDD page; or to place any standard/subaudible tone into any of the two-tone slots allocated for these type of pages.
(cont'd. on next page)</td><td>a. Momentarily move the "on/operate/off" switch on the front of all TCU's associated with the output path under test--into "off" position. (This will prevent activation signals from being sent out from the terminal.)

b. Halt the processor by depressing its HALT/ENABLE switch.

c. Load the CPU's address register with the appropriate output unit status register (STR) address by setting the processor's switch register per the following chart:

<table>
<tr><th>DDFD Output Unit</th><th>Status Register (STR) Address (octal)</th></tr>
<tr><td>first</td><td>160100</td></tr>
<tr><td>second</td><td>160110</td></tr>
<tr><td>third</td><td>160120</td></tr>
<tr><td>fourth</td><td>160130</td></tr>
<tr><td>fifth</td><td>160140</td></tr>
</table>

and then depressing the LOAD ADDRess switch once.

NOTE
See PDS-BSL in section III of the operating manual for additional details of address and data loading.</td><td>(After step a.) "tco" lamps (on TCU front panels) light.</td></tr>
</table>

Table 4-4. "Metro-Page" 10/100 Dual Function Decimal Digital (DFDD) Output Path Checkout (Cont'd.)

<table>
<tr><th>ITEM NO.</th><th>FUNCTION/MECHANISM TESTED</th><th>PROCEDURE</th><th>INDICATION</th></tr>
<tr><td>2
(cont'd)</td><td></td><td>d. Set the switch register toggle arms to:
<table><tr><td>TOGGLE ARM NO.:</td><td>7</td><td>3</td><td>2</td><td>1</td><td>0</td><td>4-6, 8-15</td></tr><tr><td>POSITION:</td><td>1</td><td>1</td><td>1</td><td>0</td><td>0</td><td>0</td></tr></table>("1" = up; "0" = down)
and momentarily raise the DEPosit switch to deposit the bits which prepare the output unit for providing a continuous tone from the tone 1 slot.
e. Set the switch register toggle arms to:
<table><tr><td>TOGGLE ARM NO.:</td><td>3</td><td>2</td><td>1</td><td>0</td><td>4-15</td></tr><tr><td>POSITION:</td><td>0</td><td>1</td><td>0</td><td>1</td><td>0</td></tr></table>("1" = up; "0" = down)
and momentarily raise the DEPosit switch. This deposits the ROM address bits associated with the 1023 Hz tone 3 into the tone 1 slot of Register 1, 2.
NOTE
The lifting of the DEPosit switch in the previous step automatically causes advance to the Register 1, 2 address (e.g. 160102 for the first output unit); it is <u>not</u> necessary to load this address via the CPU switch register toggle arms. If it were desired to place the tone data into a tone slot associated with Register 3, 4, after lifting the DEPosit switch in the previous step, depressal of the processor's EXAMine switch <u>three</u> times would cause advance to the address of Register 3, 4 (e.g. 160104 for the first output unit).
f. Deposit all zeros into the tone slot previously loaded. (Depress the EXAMine switch once before beginning in order to maintain the original location.)</td><td>- (After step e.) the tone corresponding to the ROM address selected should now be continuously heard from the test panel's loudspeaker.

- The previously selected tone should discontinue.</td></tr>
<tr><td>3</td><td>Output Unit Maintenance Response Preset Mechanism

IMPORTANT
It is necessary to perform this check <u>only</u> if the SP570306102 DFDD Output Control of the output path under test is under suspicion of fault. During initial pre-operational checking, this checkout should be skipped, and the item 4 test should be begun at this time. Refer also to the DFDD bit assignment chart (in theory of operation section III, manual 68P81007C95) when performing this test.</td><td colspan="2">The following chart prescribes a "slow motion" cycle through the "maintenance preset states" of the DFDD output unit involved. The chart also indicates the behavior which should occur within each state.

Successively perform the one or two deposits associated with each state listed in the chart. Loading of address register and deposit of data are done in the usual manner (switch register toggle arm preset followed by depressal of LOAD ADDRess to load an address; switch register toggle arm preset followed by raising of the DEPosit switch to deposit data into the loaded address).

Use the EXAMine switch as follows after each applicable deposit:

- (One depressal) if the processor's address register is to be maintained at its original location for re-deposit into that location

- (Two depressals) if the address register is to be advanced to the next following location (e.g. to get from STR address to REG 1, 2 address)

- (Three depressals) if the address register is to be advanced to the location <u>following</u> the next location (e.g. to get from STR address to REG 3, 4 address)

In addition, momentarily depress the START switch following the last deposit associated with each state (to clear the output unit)</td></tr>
</table>

Table 4-4. "Metro-Page" 10/100 Dual Function Decimal Digital (DFDD) Output Path Checkout (Cont'd.)

ITEM NO.	FUNCTION/MECHANISM TESTED	PROCEDURE	INDICATION
3 (cont'd)			

STATE	PROCESSOR ADDRESS REGISTER TO CONTAIN ADDRESS OF:	BITS FOR DEPOSIT AT SWITCH REGISTER ADDRESS (TOGGLE ARM POSITIONS) 15 14 13 12 11 10 9 8 7 6 5 4 3 2 1 0	AUDIO TO BE HEARD
REST STATE (no Morse ASI)	STR	0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1	no tone output
REST STATE (with Morse ASI)	STR	0 1 0 0 0 0 0 0 0 1 0 0 0 1 1 1 1	952 Hz dummy-tone/Morse-ASI tone
PREAMBLE	STR REG 1,2	0 0 0 0 0 0 0 0 0 1 0 0 0 1 1 1 0 ←TONE ADDRESS→ 0 0 0 0 0 0 0 0 0 0 0 0 0	tone associated with TONE ADDRESS used
GAP 1	STR	0 0 0 0 0 0 0 0 0 1 0 0 0 1 1 0 1	no tone output
TONE 1	STR REG 1,2	0 0 0 0 0 0 0 0 0 1 0 0 0 1 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 ←TONE ADDRESS→	tone corresponding to TONE ADDRESS bits used
TONE 2	STR REG 3,4	0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 1 1 ←TONE ADDRESS→ 0 0 0 0 0 0 0 0 0 0 0 0 0	tone corresponding to TONE ADDRESS bits used
TONE 3	STR REG 3,4	0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 1 0 0 0 0 0 ←TONE ADDRESS→ 0 0 0 0 0 0 0 0 0	tone corresponding to TONE ADDRESS bits used
TONE 4	STR REG 3,4	0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 0 1 0 0 0 0 0 0 0 0 0 ←TONE ADDRESS→ 0 0 0 0	tone corresponding to TONE ADDRESS bits used
TONE 5	STR REG 3,4	0 0 0 0 0 0 0 0 0 1 0 0 0 1 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 ←TONE ADDRESS→	tone corresponding to TONE ADDRESS bits used
GAP 2	STR	0 0 0 0 0 0 0 0 0 1 0 0 0 0 1 1 1	2010 Hz dual function (X) tone
GAP 3	STR	0 0 0 0 0 0 0 0 0 1 0 0 0 0 1 1 0	no tone output

NOTES:

1. FOR TOGGLE ARM POSITIONS:

   "1" = up
   "0" = down

   TONE ADDRESS = ROM ADDRESS BIT COMBINATION APPROPRIATE TO THE DFDD TONE CHOSEN:

TONE FREQUENCY (Hz)	TONE NAME	BIT COMBINATION (MSB)			(LSB)
459	R	0	0	0	1
741	1	0	0	1	1
882	2	0	1	0	0
1023	3	0	1	0	1
1164	4	0	1	1	0
1305	5	0	1	1	1
1446	6	1	0	0	0
1587	7	1	0	0	1
1728	8	1	0	1	0
1869	9	1	0	1	1
600	0	0	0	1	0

2. STR; REG 1,2; REG 3,4 ADDRESSES ARE SAME AS IN ITEM 2.

Table 4-4. "Metro-Page" 10/100 Dual Function Decimal Digital (DFDD) Output Path Checkout (Cont'd.)

<table>
<tr><th>ITEM NO.</th><th>FUNCTION/MECHANISM TESTED</th><th>PROCEDURE</th><th>INDICATION</th></tr>
<tr><td>4</td><td>DFDD Output Unit Page Generation</td><td>NOTE
This procedure (which provides for a page to be initiated from the computer front panel) verifies that the output unit timing and control circuits are correctly operating so as to accomplish page generation of any type page (DFDD/two-tone/subaudible two-tone) normally obtainable from the DFDD output unit.

a. Per item 2, load the status register (STR) address for the output unit associated with the output path under test.

b. Set the switch register toggle arms to:
<table><tr><td>TOGGLE ARM NO.:</td><td>7</td><td>5</td><td>0-4, 6, 8 - 15</td></tr><tr><td>POSITION:</td><td>0</td><td>1</td><td>0</td></tr></table>("1" = up; "0" = down)

and momentarily raise the DEPosit switch. (This deposits a low maintenance control bit and a high transmitter seize bit as would occur at the start of any normal page).

c. According to the type of page selected, choose the appropriate bits to be entered into the (now addressed) REGISTER 1, 2 location. Deposit these bits in the usual manner.
NOTE
In this and in the next step, the ROM address bit combinations placed in the time slots can be chosen to correspond to arbitrarily selected tones. (See the ROM coding charts referenced in item 2.) If desired, however, correlation between actual pager "cap codes" and corresponding tone frequencies can be done via the appropriate code-to-frequency conversion tables within the appendix section of this manual. For example, to provide the complete DFDD page associated with DFDD pager with code 9-83711, deposit "1" in bit positions 15, 13, 12, 11, 3, and 1 of the REG 1, 2 location; and "1" in bit positions 14, 12, 11, 8, 5, 4, 1, and 0-- of the REG 3, 4 location.

d. According to the type of page selected, choose the appropriate bits to be entered into the (now addressed) REGISTER 3, 4 location. Deposit these bits in the usual manner.</td><td>- (After step d.) A single page (corresponding to the data entered) should be heard from the test panel's loudspeaker; no audio should be heard following this page.</td></tr>
<tr><td>5</td><td>TCU Supply Voltage</td><td>a. With a digital voltmeter (Keithley 168 or equivalent), measure the +5V power level at pin 22 of the farthest TCU rack/connector associated with the DFDD output path under test.</td><td>- Voltage should measure at least 4.75 V.
NOTE
Due to voltage drop across the TCU +5V fuse, actual voltage at the TCU's integrated circuits may be several hundred millivolts below the value measured at the connector pin. In case of a voltage below 4.75V, adjust the +5V system power supply feeding the MTB/ATB associated with the TCU rack involved. (See maintenance section of this manual for +5V adjustment instructions.)</td></tr>
</table>

Table 4-4. "Metro-Page" 10/100 Dual Function Decimal Digital (DFDD) Output Path Checkout (Cont'd.)

<table>
<tr><th>ITEM NO.</th><th>FUNCTION/MECHANISM TESTED</th><th>PROCEDURE</th><th>INDICATION</th></tr>
<tr><td>6</td><td>TCU Page Audio Throughput (TCU manually turned on)</td><td>a. Generate a constant output tone from the DFDD output unit (as per item 2)</td><td>- Constant tone heard</td></tr>
<tr><td></td><td></td><td>b. With the digital voltmeter, in turn monitor across the output telephone line connection points for each TCU (of the output path under test) while the "on-operate-off" switch of the TCU is moved from "operate" to "on."

NOTE
See the MTB/ATB wiring diagrams in Section 2 of manual 68P81007C95 for detailed pin numbers of the output line connection points.</td><td>- (with "on-operate-off" switch in "operate"--after having been previously placed in "off.")
* tco lamp of TCU still on
-4 dBm measured across output telephone line
- (with "on-operate-off" switch in "on"):
* tco lamp of TCU extinguishes after depressal of TCU's "reset" button or CPU front panel's START switch
* Approximately -4 dBm (0.765 V rms across 600 Ω) measured across output telephone line
* For final setting see Telephone Company Line Req.
NOTE
The DFDD output unit's page audio output is set up at the factory for 0 dBm with a 459 Hz tone. For tones other than this value, the signal measured across the output telephone line will vary slightly from 0 dBm. See the NLN8296A TCU Interface Board's schematic diagram if page audio level adjustment is required due to all TCU outputs being uniformly low/high; see the NLN8334ASP3 DC TCU or the NLN8333ASP3 Tone TCU schematic if page audio level adjustment on an individual-TCU-basis is required.

IMPORTANT
(Redundant terminal configurations, only)
If a non-redundant transmitter control is used (i.e. outputs from corresponding TCU's in each terminal half tied in parallel), make sure that the NLN8876A TCU Impedance Matching Board associated with this common output is firmly in place in order to insure that the TCU under test "sees" the correct 600 Ω impedance value.</td></tr>
<tr><td>7</td><td>TCU Addressing/Control Mechanisms

IMPORTANT
For the duration of this test, all "maintenance-normal" switches (on appropriate MTB/ATB slot 19 connector cards) should be in "normal" position.</td><td colspan="2">The following procedure tests the output paths's addressing and control mechanisms without actually requiring the paging transmitter(s) to be connected. The procedure makes use of strapping performed at the TCU's to simulate transmitter signals expected under various conditions.

Perform the following, in turn, for each TCU of the output path under test:

a. Place the "on-operate-off" switch of the TCU under immediate test into "operate", and the same switch on all remaining TCUs associated with the output path--into "on".

b. Prepare the simulation strapping prescribed by each line of the following chart; for each line, cause a single test page to be issued from the associated binary output unit, and verify that the prescribed behavior is obtained.

IMPORTANT
To activate the TCU under test, use the page generation procedure described in item 4--but additionally deposit the appropriate TCU address bit information. Specifically, in step e. of item 4, in in addition to presetting high bit 5, also preset (as follows) TCU address bit positions 8-11 (of control storage register) to any TCU group address value for which an address response jumper on the TCU has not been cut:

<table>
<tr><th colspan="4">REQUIRED TOGGLE ARM POSITION</th><th rowspan="2">GROUP ADDRESS (PRESENT JUMPER)</th></tr>
<tr><th>11</th><th>10</th><th>9</th><th>8</th></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>15</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>0</td><td>14</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1</td><td>13</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>0</td><td>12</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td><td>11</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td><td>10</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td><td>9</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>0</td><td>8</td></tr>
</table>
<table>
<tr><th colspan="4">REQUIRED TOGGLE ARM POSITION</th><th rowspan="2">GROUP ADDRESS (PRESENT JUMPER)</th></tr>
<tr><th>11</th><th>10</th><th>9</th><th>8</th></tr>
<tr><td>0</td><td>1</td><td>1</td><td>1</td><td>7</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td><td>6</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td><td>5</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>3</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>2</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table>
("1" = up; "0" = down)</td></tr>
</table>

Table 4-4. "Metro-Page" 10/100 Dual Function Decimal Digital (DFDD) Output Path Checkout (Cont'd.)

<table>
<tr><th>ITEM NO.</th><th>FUNCTION/MECHANISM TESTED</th><th>PROCEDURE</th><th>INDICATION</th></tr>
<tr><td>7 (cont'd)</td><td></td><td>
<table>
<tr><th rowspan="2">SIMULATION OF:</th><th colspan="2">SIMULATION STRAPPING</th><th rowspan="2">RESPONSE (Following Entry of Test Page)</th></tr>
<tr><th>IF AN NLN8334ASP03 DC TCU</th><th>IF AN NLN8333ASP03 TONE TCU</th></tr>
<tr><td>No-on condition</td><td>---</td><td>--</td><td>- TCU's "no-on" lamp lights to indicate that (simulated) transmitter has failed to come on after being commanded to do so.
- Alarm panel's "tgf" and "tcu" alarms activated.</td></tr>
<tr><td>False-on condition</td><td>base of Q5 to GND</td><td>U3 pin 9 to GND
△1</td><td>- TCU's "fal-on" lamp lights to indicate that (simulated) transmitter has come on without being commanded to do so.
- Alarm panel's "tgf" and "tcu" alarms activated.</td></tr>
<tr><td>Proper Transmitter Response</td><td>JUX installed; JUY removed
△2 , △4</td><td>JUX and JUB installed
△3 , △4</td><td>- TCU's "xmit" lamp lights to indicate that (simulated) transmitter has turned on after being commanded to do so.</td></tr>
</table>
NOTE:
△1 In issue A tone TCU's: U4 pin 9 to GND
△2 In issue A DC TCU's: Q2 collector to Q5 base
△3 In issue A tone TCU's: U9 pin 8 to U4 pin 9
△4 If this checkout is being performed during initial installation, leave (only) the "proper transmitter response" strapping installed in each TCU in preparation for final system commissioning.
</td><td></td></tr>
<tr><td>8</td><td>-------
(Preparation for Normal Operation)</td><td>a. Restart the processor per section II (para. 4) of the operating manual.
b. Return all "busy-operate" switches to "operate"
c. If this is the last checkout required, insure that all "maintenance-normal" switches are in "normal" position; if additional checkout is required, the switches should be placed in "maintenance" position.</td><td></td></tr>
</table>

4.10 BINARY OUTPUT PATH CHECKOUT (where applicable)

Perform the checkout prescribed by Table 4-5 for each binary output path used in the terminal/terminal-half. (Binary output path = binary output unit plus its associated set of up to 24 total binary type transmitter control units.)

NOTE

For redundant terminal configurations, the checkout described by Table 4-5 should be done TWICE — once for each terminal half.

Table 4-5. Binary Output Path Checkout

ITEM NO.	FUNCTION/MECHANISM TESTED	PROCEDURE	INDICATION
1	------- (Preparations for Testing)	a. On the terminal/terminal-half to be tested, "busy-out" all input lines via the fuse panel "busy-operate" switches. CAUTION If checkout is being performed on an already working (i.e. "on-line") system wait until a data set's "busy" lamp extinguishes before placing its "busy-operate" switch to "busy". (This will insure that no calls in progress are interrupted.) b. (Perform this step only for redundant terminal configurations already "on-line" and working; for all other configurations, proceed immediately to step c.) (1) (If a Standard 10-Redundant Terminal) Place the terminal-half being tested into its "standalone" mode. (See FDS-CP in section IV of the "Metro-Page" Standard 10-Redundant Operating Manual) (2) Place the major "on/disable/reset" switch of the alarm panel in the terminal half being tested into its "reset" position. This will cause activation of the redundant switchboard relays of that terminal half thereby allowing any standby input telephone lines to connect to the opposite terminal half. It will also open up the output busy interlock to permit this terminal half to page independently. c. Select the "ou" position on the test panel's audio switch which corresponds to the specific output unit position associated with the binary output path being checked. (This allows monitoring of the page audio signal provided by the binary output unit under test.) d. Turn the test panel's volume control to about its mid-clockwise position.	-------
2	Binary Output Unit Page Generation Mechanism	The following procedure verifies that the output unit timing and control circuits are correctly operating so as to accomplish binary page generation. a. Momentarily move the "on/operate/off" switch on the front of all TCU's associated with the output path under test--into "off" position to prevent paging transmitter activation signals from being sent out from the terminal. b. Halt the processor by depressing its HALT/ENABLE switch. c. Load the processor's address register with the appropriate output unit control storage register address by setting the processor's switch register toggle arms per the following chart:	- "tco" lamps on TCU front panels light

Table 4-5. Binary Output Path Checkout (Cont'd.)

ITEM NO.	FUNCTION/MECHANISM TESTED	PROCEDURE	INDICATION
2 (cont'd)		<table><tr><th>Binary Output Unit</th><th>Control Register Address (octal)</th></tr><tr><td>first</td><td>160300</td></tr><tr><td>second</td><td>160304</td></tr><tr><td>third</td><td>160310</td></tr><tr><td>fourth</td><td>160314</td></tr><tr><td>fifth</td><td>160320</td></tr></table> and then depressing the LOAD ADDRess switch once. NOTE See PDS-BSL in section III of the operating manual for additional details of address and data loading. d. Depress the EXAMine switch once. e. Set the switch register toggle arms to: <table><tr><td>TOGGLE ARM NO.:</td><td>5</td><td>0-4, 6-15</td></tr><tr><td>POSITION:</td><td>1</td><td>0</td></tr></table> ("1" = up; "0" = down) and momentarily raise the DEPosit switch. (This deposits a high transmitter seize bit as would occur at the start of any normal page.) f. Depress the EXAMine switch twice. g. Deposit 48 data bits into (now addressed) 48-bit shift register location via three data words as follow: 1) Set up the first word's 16 bits of data on the switch register toggle arms and momentarily raise the DEPosit switch. 2) Depress the EXAMine switch once. 3) Set up the second word's 16 bits of data on the switch register toggle arms and momentarily raise the DEPosit switch. 4) Depress the EXAMine switch once. 5) Set up and enter the third word's 16 bits of data via the toggle arms and DEPosit switch. NOTE For purposes of this test, the 48 bits of data entered into the shift register location can be arbitrary. h. Depress the START switch once.	(After step e.) a constant tone at one of the modem frequencies should be heard from the test panel loudspeaker (1200 Hz if the associated NLN8883A Binary Output Board has jumper JU-A installed; 2200 Hz if jumper JU-B is installed). - (After the third data word is entered) a single binary page is heard from the test panel loudspeaker, and is followed by a continous comma tone. - Comma tone discontinues (output unit is reset)
3	TCU Supply Voltage	a. With a digital voltmeter (Keithley 168 or equivalent), measure the +5 V power level at pin 22 of the farthest TCU rack/ connector associated with the binary output path under test.	- Voltage should measure at least 4.75 V. NOTE Due to voltage drop across the TCU +5 V fuse, actual voltage at TCU's integrated circuits may be several hundred millivolts below the value measured at the connector pin. In case of a voltage below 4.75 V, adjust the +5 V system power supply feeding the MTB/ ATB associated with the TCU rack involved. (See maintenance section of this manual for +5 V adjustment instructions.)
4	TCU Page Audio Through-put (TCU manually turned on)	a. Generate a constant 1200 Hz modem tone from the binary output unit (as per item 2 steps a. through e.)	- Constant 1200 Hz tone heard

Table 4-5. Binary Output Path Checkout (Cont'd.)

<table>
<tr><th>ITEM NO.</th><th>FUNCTION/MECHANISM TESTED</th><th>PROCEDURE</th><th>INDICATION</th></tr>
<tr><td>4
(cont'd)</td><td></td><td>b. With the digital voltmeter, in turn monitor across the output telephone line connection points for each TCU (of the output path under test) while the "on-operate-off" switch of the TCU is moved from "operate" to "on".

NOTE
See the MTB/ATB wiring diagrams in the maintenance section (section 2) for detailed pin numbers of the output line connection points.</td><td>- (With "on-operate-off" switch in "operate"--after having previously been placed in "off"):
* tco lamp of TCU still on
* -4 dBm measured across output telephone line
- (With "on-operate-off" switch in "on"):
* tco lamp of TCU extinguishes after depressal of TCU's reset button or CPU front panel's START switch
* Approximately -4 dBm (0.765 V rms across 600 Ω) measured across output telephone line
* For final setting, see Telephone Company Line Req.
NOTE
The binary output unit's page audio output is set up at the factory for 0 dBm with the 1200 Hz tone. See the NLN8883A Binary Output Board's schematic diagram if page audio level adjustment is required due to all TCU outputs being uniformly low/high; see the NLN8748A Binary TCU schematic diagram if page audio level adjustment on an individual-TCU-basis--is required.
IMPORTANT
(Redundant terminal configurations only)
If a non-redundant transmitter control arrangement is used (i.e. outputs fron corresponding TCU's in each terminal half tied in parallel), make sure that the NLN8876A TCU Impedance Matching Board associated with this common output is firmly in place in order to ensure that the TCU under test "sees" the correct 400-ohm impedance value.</td></tr>
<tr><td>5</td><td>TCU Addressing/Control Mechanisms

IMPORTANT
For the duration of this test, all "maintenance-normal" switches (on appropriate MTB/ATB slot 19 connector cards) should be in "normal position.</td><td colspan="2">The following procedure tests the output path's addressing and control mechanisms without actually requiring the paging transmitter(s) to be connected. The procedure makes use of strapping performed at the TCU's to simulate transmitter signals expected under various conditions.

Perform the following, in turn, for each TCU of the output path under test:

a. Place the "on-operate-off" switch of the TCU under immediate test into "operate", and the same switch on all remaining TCUs associated with the output path--into "on".

b. Prepare the simulation strapping prescribed by each line of the following chart; for each line, cause a single test page to be issued from the associated binary output unit, and verify that the prescribed behavior is obtained.

IMPORTANT

To activate the TCU under test, use the page generation procedure described in item 2--but additionally deposit the appropriate TCU address bit information. Specifically, in step e. of item 2, in addition to presetting high bit 5, also preset (as follows) TCU address bit positions 8-11 (of control storage register) to any TCU group address value for which an address response jumper on the TCU has not been cut:

<table>
<tr><th colspan="4">REQUIRED TOGGLE ARM POSITION</th><th rowspan="2">GROUP ADDRESS (PRESENT JUMPER)</th></tr>
<tr><th>11</th><th>10</th><th>9</th><th>8</th></tr>
<tr><td>1</td><td>1</td><td>1</td><td>1</td><td>15</td></tr>
<tr><td>1</td><td>1</td><td>1</td><td>0</td><td>14</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>1</td><td>13</td></tr>
<tr><td>1</td><td>1</td><td>0</td><td>0</td><td>12</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>1</td><td>11</td></tr>
<tr><td>1</td><td>0</td><td>1</td><td>0</td><td>10</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>1</td><td>9</td></tr>
<tr><td>1</td><td>0</td><td>0</td><td>0</td><td>8</td></tr>
</table>

<table>
<tr><th colspan="4">REQUIRED TOGGLE ARM POSITION</th><th rowspan="2">GROUP ADDRESS (PRESENT JUMPER)</th></tr>
<tr><th>11</th><th>10</th><th>9</th><th>8</th></tr>
<tr><td>0</td><td>1</td><td>1</td><td>1</td><td>7</td></tr>
<tr><td>0</td><td>1</td><td>1</td><td>0</td><td>6</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>1</td><td>5</td></tr>
<tr><td>0</td><td>1</td><td>0</td><td>0</td><td>4</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>1</td><td>3</td></tr>
<tr><td>0</td><td>0</td><td>1</td><td>0</td><td>2</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>1</td><td>1</td></tr>
<tr><td>0</td><td>0</td><td>0</td><td>0</td><td>0</td></tr>
</table>
("1" = up; "0" = down)</td></tr>
</table>

Table 4-5. Binary Output Path Checkout (Cont'd.)

ITEM NO.	FUNCTION/MECHANISM TESTED	PROCEDURE	INDICATION
5 (cont'd)			

SIMULATION OF:	SIMULATION STRAPPING WITHIN NLN8748 Binary TCU	RESPONSE (Following Entry of Test Page)
No-on condition	-------	- TCU's "no-on" lamp lights to indicate that (simulated) transmitter has failed to come on after being commanded to do so. - Alarm panel's "tgf" and "tcu" alarms activated.
False-on condition	Short test point TP1 to GND	- TCU's "fal-on" lamp lights to indicate that (simulated) transmitter has come on without being commanded to do so. - Alarm panel's "tgf" and "tcu" alarms activated.
Proper Transmitter Response	U7 pin 9 to TP1 ⚠1	- TCU's "xmit" lamp lights to indicate that (simulated) transmitter has turned on after being commanded to do so.

NOTE:
⚠1 If this checkout is being performed during initial installation, leave (only) the "proper transmitter response" strapping installed in each TCU in preparation for final system commissioning.

6	------- (Preparation for Normal Operation)	a. Restart the processor per section II (para. 4) of the operating manual. b. Return all "busy-operate" switches to "operate" c. If this is the last checkout required, insure that all "maintenance-normal" switches are in "normal" position; if additional checkout is required, the switches should be placed in "maintenance" position.	

4.11 PRE-OPERATIONAL TEST OF REMOTE TERMINALS

With the remote terminal and modem in the same room as the system, connect the remote modem to the system modem with a twisted wire pair. Insert approximately 20 dB attenuation between the modems using a 600 ohm pad, if one is available. Strap the remote modem for the originate mode and the system modem for the answer mode, referring to the modem manual as required. Having completed the preceding setup, power-up both the remote modem and terminal and the local modem and system half to which it is connected. Using the PDP11 front panel switches, set-up and verify the operation of the modems, interface, and remote terminal with the following sequence:

Step 1. Load address 1740X0; where X equals 0 for the first unit, 1 for the second unit, etc.

Step 2. Deposit 0000Y1; where Y equals 0 if data transfer rate is 10 characters per second, or 3 if data transfer rate is 30 characters per second.

NOTE

The preceding rates are for common remote terminal configurations. Refer to the DC11 users manual for any other data transfer rates.

Step 3. Load address 1740X6.

Step 4. Deposit 000WW1; where WW equals 00 if data rate is 10 characters per second, or 43 if data rate is 30 characters per second.

Step 5. Load address 1740X6.

Step 6. Deposit 000101; remote terminal should respond by printing an A.

Step 7. Enter the character B on the remote terminal keyboard.

Step 8. Load address 1740X2.

Step 9. Depress the Examine switch; the data display lights should indicate 000102.

If the preceding procedure was successful, load the operating software into the system and configure the remote terminals using FDS-TY function, refer to the Operating manual. The remote terminal should now be functional. To verify, "logon" with the ID function, then perform several of the user functions listed in the Operating manual.

If the preceding is unsuccessful, perform the DC11 off-line diagnostics to verify the operation of it (see paragraph 4.2 for set-up). If the DC11 off- line test executes with no errors, verify the operation and strapping of the modems.

Having successfully completed the preceding checkout procedure, connect the system modem to the appropriate telephone line and move the remote terminal to its remote site.

5. EXTERNAL INTERFACE

5.1 INPUT DATA SET SPECIFICATIONS

5.1.1 Input Data Set (Touch-Tone)

Power Supply	5 V dc, 12 V dc — Supplied by Metro-Page terminal
Ringing Requirements	60-130 V rms, 16-66 Hz
Input Impedance (Tip to Ring)	ON-HOOK: AC 65k ohms, DC open circuit. OFF-HOOK: AC 900 ohms balanced to ground, DC 400 ohms (180 ohms for ring tripping)
Signals Accepted	2 of 7 simultaneous tones (2 of 8 optional)
Tone Frequencies	697, 770, 852, 941, 1209, 1336 and 1477 Hz
Decoding Time	40 ms
Interdigit Time	45 ms
Input Signal Range	-26 dBm minimum, + 10 dBm maximum
Maximum Level Difference Between Simultaneous Tones	10 dB
Minimum Signal to Noise Ratio	+ 6 dB
Maximum Tone Frequency Shift	± 1.5%
Audio Output Level	0 dBm maximum, -3 dBm nominal (adjustable)
Audible Responses	Go-ahead tone. Valid call tone or voice message. Invalid call tone or voice message.
DC Applied to Phone Line	None. Inband hum and noise input maximum 26 dBRNC.

5.1.2 Input Data Set (Dial Pulse)

Power Supply	5 V dc supplied by Metro-Page terminal. -48 V dc provided by station battery or optional Motorola -48 V Power Supply Kit.
Input Impedance	600 ohms nominal, balanced to ground
Signals Accepted	Dial pulses
Pulsing Requirements	7-13 pps or 18-22 pps, 56-64% break. (10 pps nominal is standard)
Minimum Interdigit Time	300 ms
Maximum Loop Resistance	1600 ohms
Line Supervision	Normal — reverse battery supervision. Sleeve lead supervision is supplied.
Audible Responses	Ring-back tone (interrupted). Valid call tone or voice message. Invalid call tone or voice message.
Audio Output Levels	0 dBm maximum, -3 dBm nominal (adjustable)
Inband Hum and Noise Input	Maximum 26 dBRNC.

5.2 SELECTOR LEVEL SUPERVISION

The "Metro-Page" selector level input data set is designed to operate with several types of central offices. The interface requirements and standard options are outlined below. Every effort should be made to insure that the particular central office(s) to which the paging terminal is connected will be compatible with these requirements and options. Otherwise, the input data sets and/or system software will have to be custom designed for the maverick central office interface, with an accompanying higher price for the (SP) terminal. These requirements should be discussed thoroughly, well in advance of the installation of the terminal to insure that unexpected complications will not arise.

5.2.1 Central Office Line Seizure (Indication that a call is ready for terminal processing)

The central office must apply resistance across tip and ring. Total loop resistance seen by the input data set must be between 400 and 1600 ohms. This resistance must remain across tip and ring for the duration of the call, except that momentary removal is allowed during each dial pulse.

5.2.2 Pulsing Requirements

The terminal will operate correctly with 7 to 13 pulses per second at 56 to 64% break.

5.2.3 Minimum Interdigit Time

A minimum 300 msec is required between digits.

5.2.4 Tip and Ring Supervision

During idle conditions, the data set applies 48 V dc in series with 400 ohms (balanced) to tip and ring, with the positive polarity connected to tip. One-half second after a valid pager number has been received, the data set reverses tip-ring polarity for the duration of the time that the calling party is receiving ringback and valid tone signals. The ringback period is normally six seconds but is adjustable from one to twenty-five seconds. After the three second valid tone, the polarity is returned to normal. If the central office line seizure goes away any time for longer than 160 msec, the polarity is returned immediately to normal and the data set resets, ready for a new call. If a line seizure goes away prior to the end of the ringback period, the page will not be transmitted.

In the event that the calling party has dialed an invalid pager number, the tip-ring polarity remains unchanged until after the ringback and invalid message have finished. At that point the terminal reverses the polarity for one-half second and then restores normal polarity. Again the central office should remove line seizure as soon as possible after the polarity is returned to normal. If the central office line seizure goes away for longer than 160 msec prior to the completion of the invalid message, the polarity remains normal and the data set resets, ready for a new call.

5.2.5 Sleeve Supervision (Optional, but desirable)

A third connection (sleeve) is provided by the Metro-Page input data set for line supervision. In processing a call the terminal may cause the sleeve lead to become either "active" or "inactive", as described in the following paragraph. Jumpers are provided on the input data sets for six sleeve lead activity options. Table 5-1 shows the six options.

Table 5-1. **Standard Jumper Options for Sleeve Control**

Option	Terminal makes Sleeve Active by	Terminal makes Sleeve Inactive by
1	Resistance Battery*	Ground
2	Resistance Battery	Open Circuit
3	Open Circuit	Ground
4	Ground	Resistance Battery
5	Open Circuit	Resistance Battery
6	Ground	Open Circuit

*Resistance battery is negative 48 volts in series with 500 or (optionally) 1000 ohms.

The sleeve lead is always inactive when there is no call in progress on the data set. Normally, the data set activates the sleeve immediately after the central office has seized the line. The sleeve then remains active until the call is terminated either by the removal of central office seizure any time or by the terminal at the completion of the valid tone or invalid message. The central office should remove line seizure as soon as possible after the sleeve is deactivated by the terminal.

Optionally, (by moving a jumper) the sleeve may be left inactive throughout the call and activated only at the end of the call, after the completion of the valid tone or invalid message. The sleeve will remain active until the central office removes line seizure. In this case, the central office should remove line seizure as soon as possible after the sleeve is activated.

Regardless of how the jumpers are connected, the sleeve is always activated whenever its controlling data set is placed "out of service" by the computer due to bad data, or in the event of a power failure in the system. The central office should interpret this condition as a busy if possible, to avoid completing a call to a dead data set.

In the event that a sleeve lead is not available from the telephone company, the terminal may be operated without sleeve lead control. In this case there is generally no way of making the line busy in the event of an "out of service" data set or a power failure.

5.3 OUTPUT LINE REQUIREMENTS

Line requirements to connect transmitter control units to transmitters. C1 conditioning is the minimum acceptable line, while C2 and C4 conditioning provide additional margin.

		C1 Conditioning	C2 Conditioning	C4 Conditioning
I.	Circuit Designation Use (Note D + G) Interstate Tariff FCC No. 260	Alternate Voice/Data or Data only	Alternate Voice/Data or Data only	Alternate Voice/Data or Data only
II.	General Characteristics			
	Type of Service	2-Point or Multipoint	2-Point or Multipoint	2 Point or 3-Point (Note F)
	Mode of Operation	Half or Full Duplex	Half or Full Duplex	Half or Full Duplex
	Method of Termination	2-Wire or 4-Wire	2-Wire or 4-Wire	2-Wire or 4-Wire
	Imped. Source & Load	600 ohm-Resistive Bal.	600 ohm-Resistive Bal.	600 ohm-Resistive Bal.
	Maximum Signal Power (Note H)	0 dBm for Composite Data Signal, 0VU for Voice	0 dBm for Composite Data Signal, 0VU for Voice	0 dBm for Composite Data Signal, 0VU for Voice
III.	Attenuation Characteristics			
	Meas. between 600 ohm Impedances at Lineup (Recommended)	16 dB ± 1 dB @ 1000 Hz	16 dB ± 1 dB @ 1000 Hz	16 dB ± 1 dB @ 1000 Hz
	Expected Max. Var. of (L) (Note A)	Short term ± 3 dB Long term ± 4 dB	Short term ± 3 dB Long term ± 4 dB	Short term ± 3 dB Long term ± 4 dB
	Frequence Response (Ref. 1000 Hz) (Note B)	Freq. Range Var. dB * 300-2700, -2 to + 6 * 1000-2400, -1 to + 3 2700-3000, -3 to + 12	Freq. Range Var. dB * 300-3000, -2 to + 6 * 500-2800, -1 to + 3	Freq. Range Var. dB * 300-3200, -2 to + 6 * 500-3000, -2 to + 3
	Frequency Error	± 5 Hz	± 5 Hz	± 5 Hz
IV.	Delay Characteristics			
	Absolute delay (Note C)	Not Specified	Not Specified	Not Specified
	Envelope delay distortion	* Less than 1000 Microseconds over band from 1000-2400 Hz * Less than 1750 Microseconds over band from 800-2600 Hz	* Less than 500 Microseconds 1000-2600 Hz * Less than 1500 Microseconds 600-2600 Hz * Less than 3000 Microseconds 500-2800 Hz	* Less than 300 Microseconds 1000-2600 Hz * Less than 500 Microseconds 800-2800 Hz * Less than 1500 Microseconds 600-3000 Hz * Less than 3000 Microseconds 500-3000 Hz
V.	Noise Characteristics			
	Message Circuit Noise Impulse Noise (Note E & H)	15 counts in 15 minutes @ 69 dBm VB (69 dBm C)	15 counts in 15 minutes @ 69 dBm VB (69 dBm C)	15 counts in 15 minutes @ 69 dBm VB (69 dBm C)

Conditioned Line Specifications — Details can be found in FCC Tariff No. 260

NOTES

A. (L) is the net loss as measured at 1000 Hz. Short term variations are those likely to be observed during a measurement interval. They are caused by amplitude and phase hits, dropouts, and maintenance activities. Long-term variations include seasonal changes, tube aging, etc.

B. DC continuity is not provided on any of these offerings.

C. Absolute delay and propagation times are not specified. Where satellite channels are employed, the delay may be several tenths of a second and telemetry and retransmission schemes may be either unusable or limited.

D. If alternate voice data operation is desired and the data modulation does not allow the use of compandors (such as many AM systems where instantaneous power varies rapidly), the voice mode may be degraded by excessive noise. If signaling is required, the data modulation must not interfere with 2600 Hz S. F. signaling units and response is not specified between 2450 and 2750 Hz.

E. These impulse noise limits are primarily plant maintenance limits. In cases where they are exceeded, Engineering will evaluate the performance on impulse noise distribution; i.e., how rapidly the counts (impulses) fall off as counting level (impulse noise peak voltage) is raised, and the effect on the data system performance.

F. Third-point operation describes the conditioning where point A (master) can transmit to B and C (slaves) simultaneously and both B and C can respond to A. Transmissions between B and C are possible, but the characterics are not specified.

G. C3 Conditioning, not included in this table, describes conditioning of access lines and trunks in central office switching applications. An end-to-end connection consisting of four trunks and two access lines with C3 will approximate C2 conditioning overall.

H. The "vb" in the objectives refers to the voiceband filter in the measuring set. This approximates the "C" message filter and the typical response of the voice grade channel.

5.4 "METRO-PAGE" TERMINAL SPECIFICATIONS

Number of Subscribers	10,000 maximum — "METRO-PAGE 10" and 100,000 plus — "METRO-PAGE 100"
Number of Input Lines	24 maximum — "METRO-PAGE 10" and 160 maximum — "METRO-PAGE 100"
Types of Inputs	Touch-Tone (end-to-end) and Dial Pulse (selector level)
Coding Types	Tone: Decimal digital (Std), 2-Tone Sequential (Opt), 2-Tone Sequential Sub-Audible (Opt) or Binary Digital
Power Requirements	115 V ac, 60 Hz, 20 Amps or 230 V ac, 50 Hz, 10 Amps or Inverter -48 V dc, 60 Amps
Paging Tone Stability	.05%
Number of Repeat Pages	0, 1.
Number of Output Groups	16 maximum
Number of Sequenced Transmitter Groups	8 maximum
Transmitter Control	DC, Tone Remote Control, or Binary
Dimensions	Basic terminal cabinet — 72 x 21-3/4 x 30 inches (1829 x 552 x 762 mm) Teletype — 34 x 21-1/2 x 17 inches (864 x 546 x 762 mm)
Announcers	Automatic Station Identifier Unit (1) per call sign desired (1st identifier is standard), Invalid Call Announcer (standard) and Valid Call Announcer (extra cost option)

5.5 CONVERTING TO REDUNDANT "METRO-PAGE 10" TERMINAL AND "METRO-PAGE 100" TERMINAL

The modular design of the "Metro-Page" terminals provides for expansion of an initial small 200-subscriber system to the ultimate system of 100,000 or more subscribers as shown in Figure 5-1.

5.5.1 Converting To Redundant "Metro-Page 10" Terminal

The terminal system can be configured for redundant operation at any subscriber level. This is accomplished simply by adding a second "Metro-Page 10" terminal plus a data transfer module and redundancy kit. An additional block of memory per terminal is also required to hold the redundancy programming. This system expansion is pictorially shown in Figure 5-1.

The modification consists of (1) distributing the input trunks between the two terminals on an alternate basis (in order to assure an even traffic distribution), (2) plugging in the data transfer modules, (3) connecting the redundancy kit, and (4) entering a computer program via a Motorola supplied paper tape to allow transfer between the redundant paging system halves. The configuration now resembles two "Metro-Page 10" systems operating in parallel with their respective transmitter control units connected in common to the transmitter.

Each terminal has a complete subscriber list. The terminals independently process and store calls entering their particular input units. Changes in call count and modifications in subscriber lists are transferred from one terminal to the other via the data transfer modules, thus assuring automatic updating of the subscriber lists in each terminal. When transmitting paging calls, one terminal is locked out by the other so that there is no interruption in output processing.

In the event of a terminal failure, input lines of that particular terminal are busied out and the traffic is routed to the operating half of the system which assumes the entire system burden. The downtime of the malfunctioned terminal may or may not produce a reduced grade of of service depending upon the input configuration used.

5.5.2 Converting To "Metro-Page 100" Terminal

The expansion of smaller subscriber redundant systems to the Metro-Page 100 system configuration is accomplished by the simple addition of disc memories to each half of the system and the entry of disc access programs. Three memory kits are required per system half. Subscriber lists are placed in disc storage.

5.5.2.1 Redundant Terminal Input Considerations

- Normal Input Lines

  For typical paging systems with inputs from telephone apparatus of the type which will "hunt"

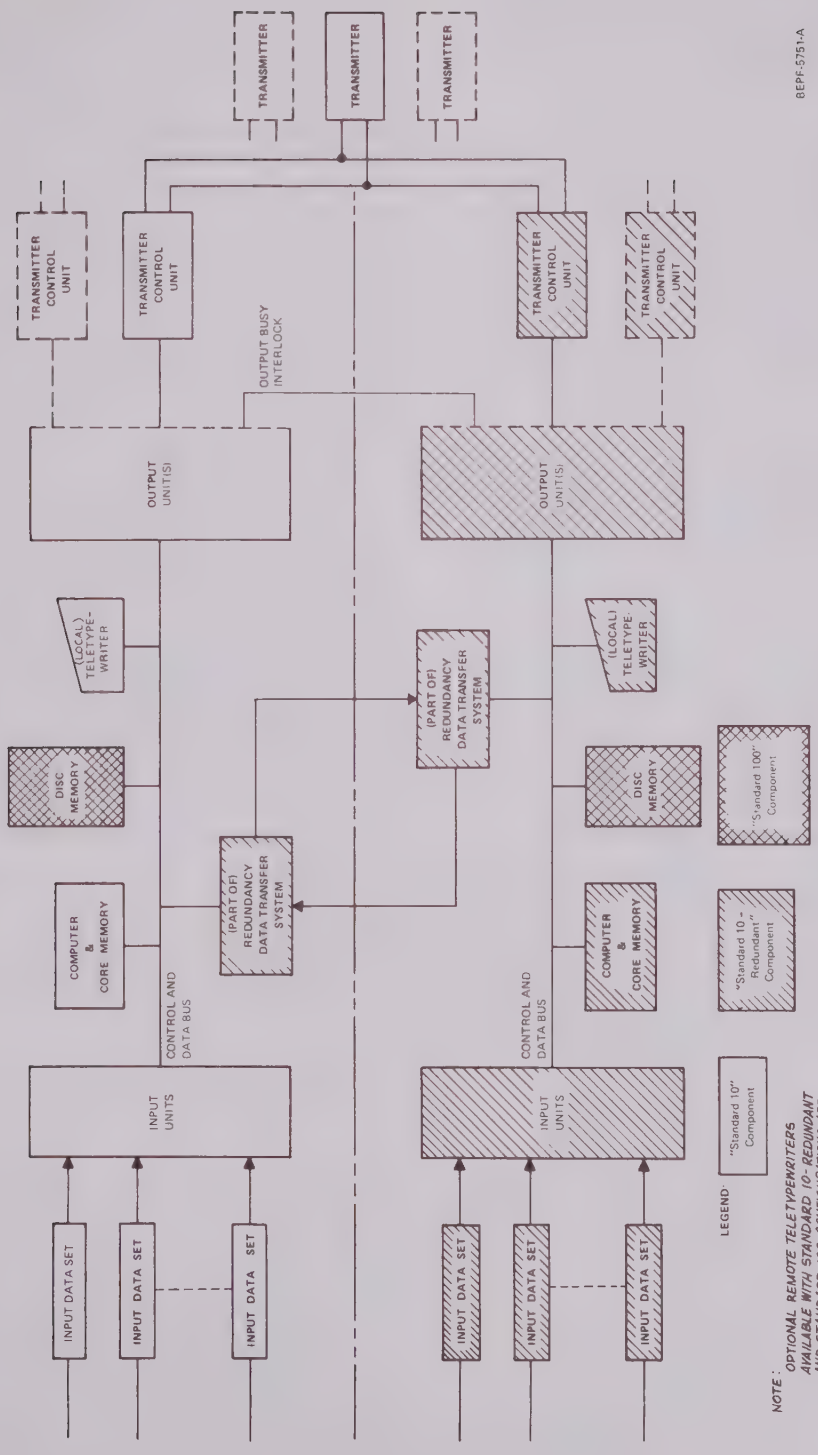


Figure 5-1. "Metro-Page" 10/100 Terminal System Expansion

among a group of input data sets to find an idle data set, there are several approaches for connecting the inputs to a redundant terminal. These schemes, which have been given the names "Split", "All Switched", and "Combination" are described as follows:

- Split Scheme

Split input redundancy, as the name implies, refers to a system in which the inputs are equally divided between the two halves of a redundant terminal. In the event of failure of one half of the terminal, all the input lines associated with that half would be made busy, and the telephone system would be relied upon to rotate all incoming calls to the working terminal half. Figure 5-2 depicts the split input redundant terminal.

The advantage of the split input scheme is that under normal conditions all input data sets can be used - none are in a stand-by mode - thus, this system provides a minimum cost solution to redundancy. A disadvantage of the split scheme is the large degradation in traffic handling capability which results from the loss of half of the input data sets whenever one side of the redundant terminal is not operating. For example, a redundant terminal with 10,000 subscribers typically would need 16 input lines and data sets to handle the busy-hour traffic with a low probablity of call blocking. (Less than 2% of the incoming calls would get a busy signal.) If half the input lines were removed from service by the loss of one side of the redundant terminal, then the probablity of call blocking would increase radically. (Approximately 60% of the incoming calls would now find all the lines busy, and would have to be redialed.) This disadvantage can be reduced or eliminated by configuring the system with more input lines and data sets than actually are required for normal conditions, with the accompanying new disadvantage of higher operating cost.

- All Switched Scheme

In the event that the redundant terminal is required to maintain a constant probablity of call blocking, even when operating on only one half, the all switched scheme must be used for the inputs. In this system, half of the input lines normally are connected to each half of the redundant terminal. In the event of the loss of one half of the terminal, the lines connected to the failing side are automatically switched over to stand-by data sets on the operating side, so that the total number of input lines in service never changes. This scheme is shown in Figure 5-3.

While the all switched scheme might seem to be the best choise for input redundancy, it is definitely more costly, requiring twice as many input data sets as input lines.

- Combination Scheme

A scheme which provides some degree of the advantages of both the split and the all switched methods is the combination scheme, which, not surprisingly, uses some switched in the event of the loss of one half of the terminal. Figure 5-4 shows the combination method. It is the scheme which generally will provide the best approach to input redundancy consistent with both minimum operating cost and reasonable probablities of call blocking.

This will be demonstrated with an example.

A system is to be designed with the following specifications:

Number of Subscribers: 10,000
Traffic Rate (busy hour): 0.15 call/user hr.

Holding Time: 20 seconds

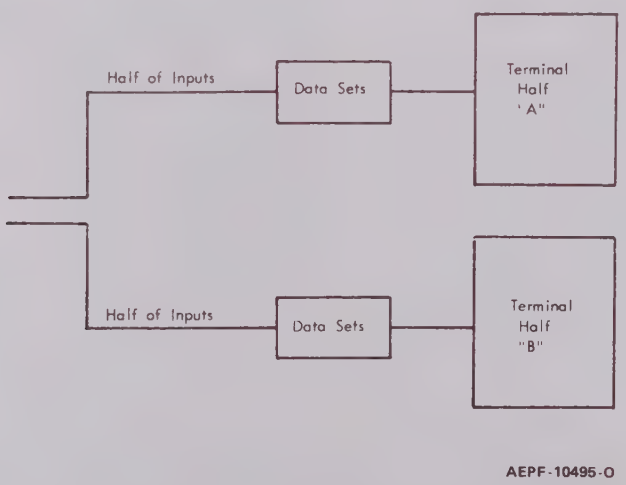


Figure 5-2. Split Input Redundancy

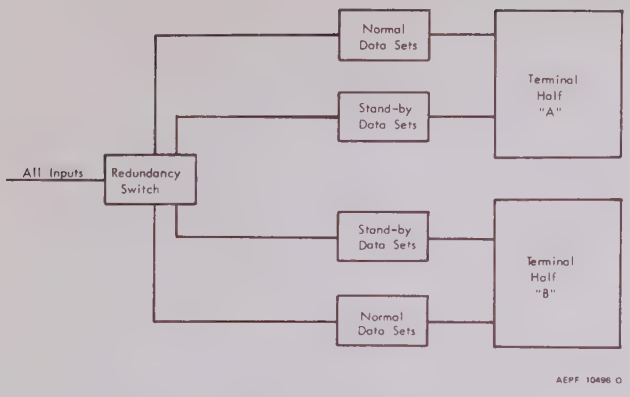


Figure 5-3. All Switched Input Redundancy

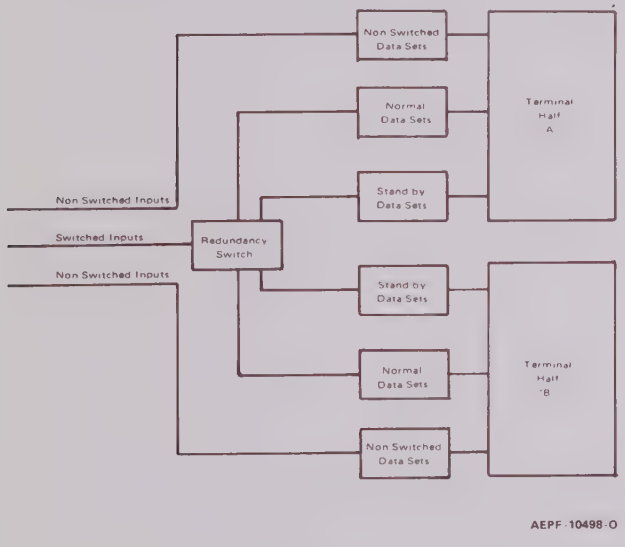


Figure 5-4. Combination Input Redundancy

Then the mean number of simultaneous calls (traffic units) is:

$$E = \frac{(10{,}000)(0.15)(20)}{3600} = 8.3 \text{ erlangs}$$

The owner of the paging terminal has decided that he wishes to operate with a 1% probablity of call blocking when both sides of the terminal are operating. He is willing for the probablity of call blocking to increase to 10% whenever one half of the terminal is out of service. From Figure 5-5, the number of required operating input lines for 1% blocking probablity is 16; the number required for 10% blocking is approximately 12 input lines. Thus, the system must have at least 12 lines in service during the failure of one half of the terminal, and at least 16 lines in service when both halves are operating. Figure 5-6 shows systems designed to meet these requirements using all three input redundancy schemes for the purpose of comparison. As indicated, the split scheme requires a total of 24 input lines and 24 data sets. The all switched scheme requires 16 input lines and 32 data sets. The combination scheme requires 16 input lines and 24 data sets. It is clear, then, that the combination scheme is the only one which meets all the input requirements while minimizing the number of both input lines and data sets.

In the general case the total number of input lines required in the combined scheme is always equal to the number of lines needed when both halves of the terminal are working. The number of non-switched lines connected to each half of the redundant terminal is always equal to the number of lines whose loss is acceptable in the event of the failure of one half. The remainder of the lines must be switched, and data sets must be provided for these lines in BOTH halves of the terminal.

In general, then, if the number of lines normally required is N, and the number which will suffice when one side is not operating is F, then the following formulae apply.

Total Number of input lines — N
Total number of non-switched lines = 2(N-F)
Total Number of switched lines = N -2(N-F) = 2F-N
Total Number of data sets = 2(N-F) + 2(2F-N) = 2F

- Special Input Lines

In some installations some of the terminal input lines must remain in service at all times. Examples of these types of lines are remote teletype, multiplex, and special bulk-use lines. Because of their requirements for continuous operation, these lines must use the all-switched method of input redundancy. The existence of these special lines would not preclude the use of the combined scheme for the remainder of the (normal) input lines in the same paging system.

Table 5-2.
Redundancy Switch Board Requirements

The basic redundant "Metro-Page 10" NLN1232 Redundancy Kit contains a pair of redundancy switch boards and mounting room for seven (7) more pairs. The number of contacts required varies with the system size and configuration and may be determined as follows:

Number of switched input lines	x 3 = *	___
Number of transmitters	x 4 =	___
Number of remote teletypes	x 2 =	___
Number of dial multiplex inputs	x 2 =	___
Number of output units	x 1 =	___
TOTAL	=	___

Divide the total by 24 and round to the next higher number. The total number of added Redundancy Switch Kits (NLN8700) required is one less than this number, since one kit is contained in the basic redundancy kit.

* Multiply by 2 if no sleeve lead required.

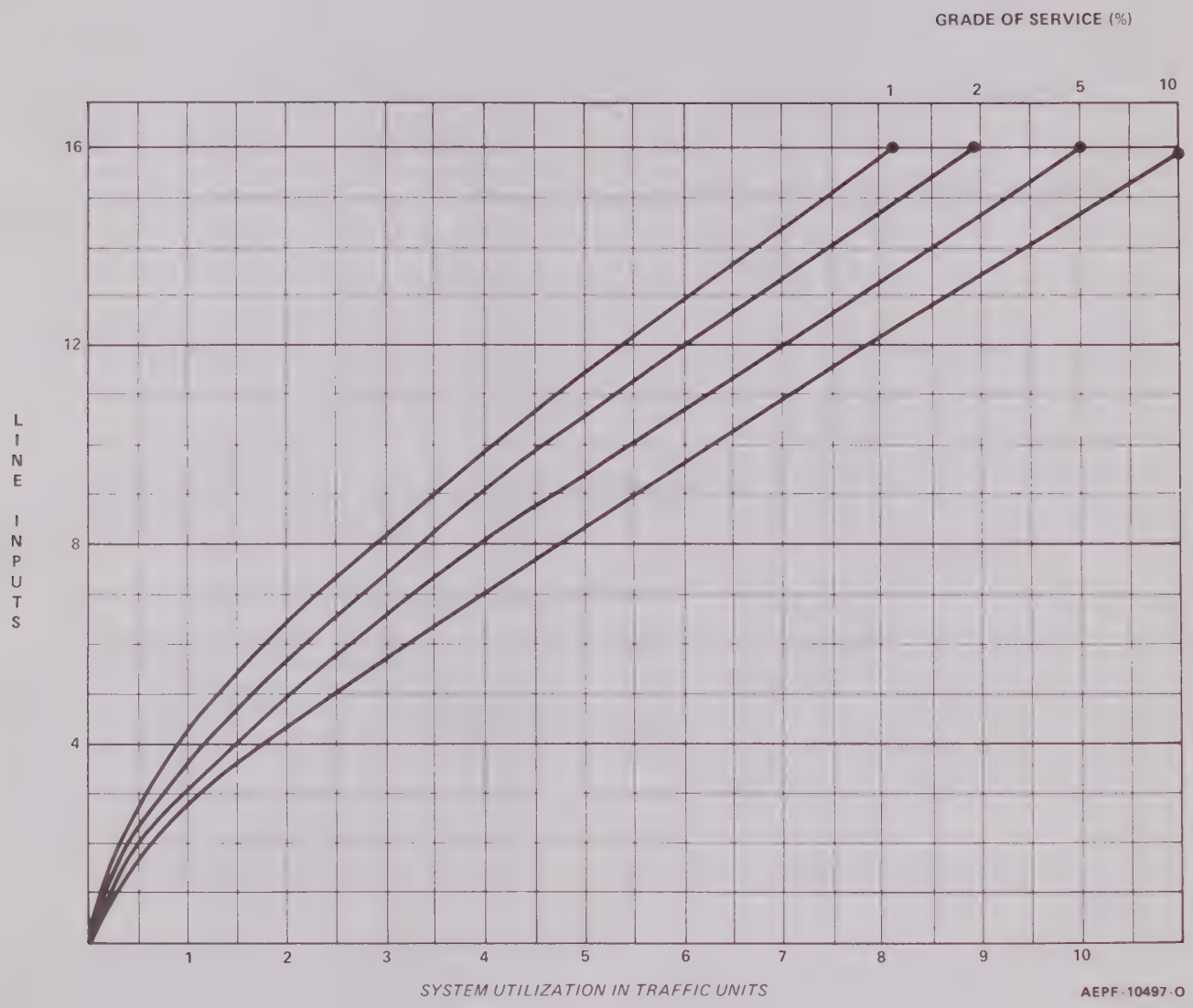


Figure 5-5. Grade of Service (Call Blocking)

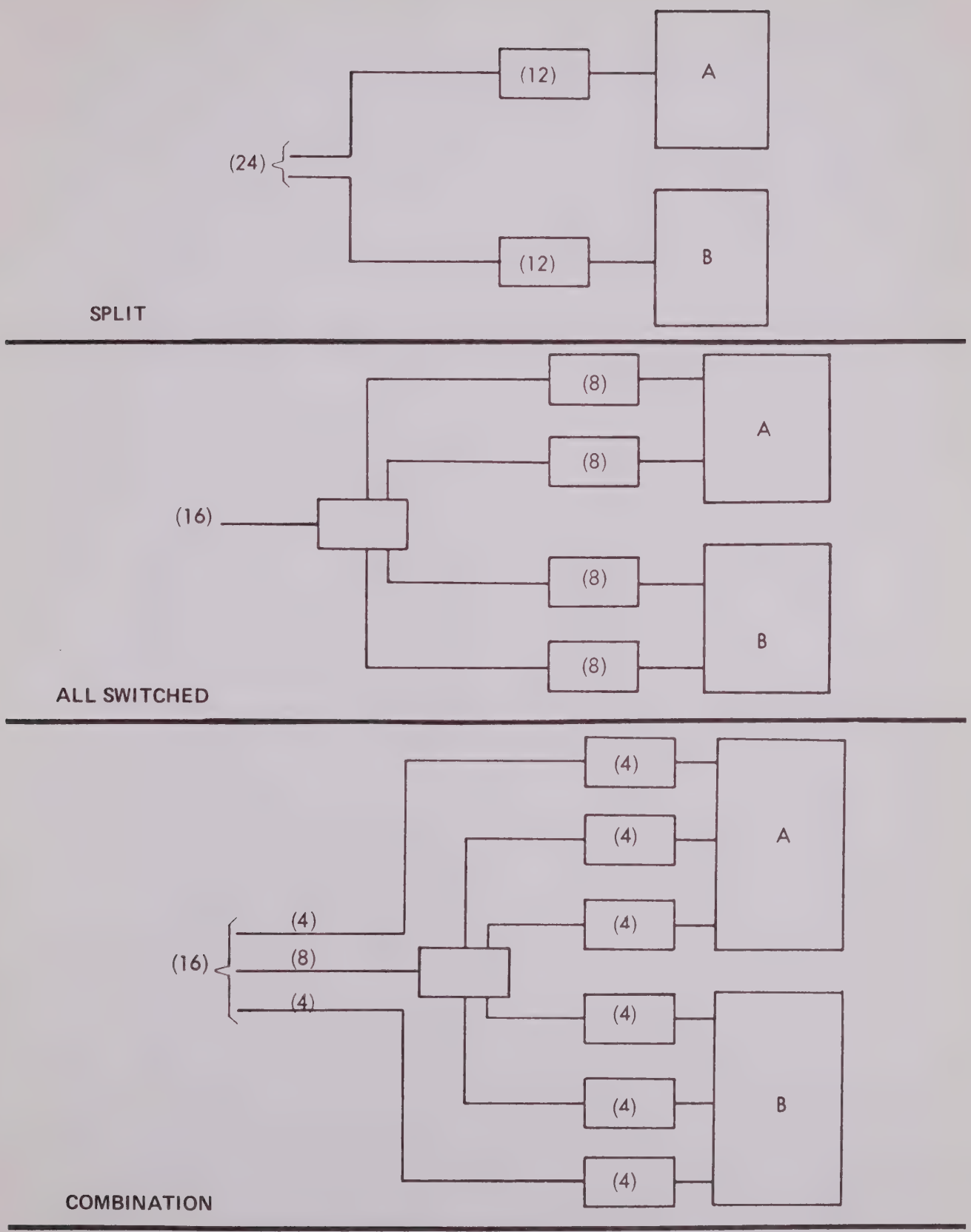


Figure 5-6. Input Configurations For A 10,000 User System With 1%/10% (Call Blocking Requirement)

AEPF-10499-O

6. SYSTEM TESTING/ACCEPTANCE (WITHOUT T&I BAY)

6.1 COMMISSIONING THE PAGING TERMINAL

Assuming all preoperational checks prove satisfactory, the paging terminal may be commissioned as follows:

CAUTION

Terminal power should always be turned off when installations/connections are made.

6.1.1 Initial Configuration of Paging Terminal

System parameters used during initial configuration are contained in the supplied system parameter worksheets.

NOTE

A blank system parameter worksheet, may be found at the end of this section. It should be completed prior to initial configuration or change in configuration parameters. The page references in the following procedures are contained in the Operating Manual

Step 1. For P.T. load bootstrap and absolute loads. If system has Boot/ROM use ROM to load absolute loader.

Step 2. Load utility program and clear disk.

Step 3. Load system Program.

Step 4. Enter # of paging areas, # of service areas, and # of users. See page II-7 Operating Manual.

Step 5. Load library program.

Step 6. Specify user parameters, see FDS sheet US page IV-45.

Step 7. Specify output unit, see FDS sheet OU on page IV-27.

Step 8. Specify paging area parameters, see FDS sheet AR page IV-2.

Step 9. Specify service area parameters, see FDS sheet SA page IV-30.

Step 10. Specify data set parameters, see FDS sheet DS page IV-14.

Step 11. Specify required call signs, see FDS sheet CS page IV-8.

Step 12. Using the ID function (p. IV-21), "logon" as each user password specified under US command. Specify subscriber directory for appropriate user as defined on system worksheet. See FDS sheet DI page IV-12.

Step 13. Using ID function, "logon" as each user and enter appropriate cap code for test pagers and activate for test subscribers. See FDS sheet CH page IV-6, and Appendix C for pager code entry format.

Step 14. Generate system backup, see FDS sheet BP page IV-3.

Step 15. Halt opposite side and load utility program in terminal half, then clear disk and initiate swap receive by entering SR to the utility program. Initiate swap send on the active side by entering RE followed by SW command. System will swap disk contents to other disk and print when finished.

Step 16. Load utility program and clear disk. Load system backup, using utility program on other half. This is to verify backup. Note, Step 15 must be performed again to obtain redundant operation.

6.1.2 Final Pre-Operational Checkout Summarized By Table 6-1.

Table 6-1. "Metro-Page" 10/100 Final Preoperational Checkout

ITEM	PROCEDURE	INDICATION
Initial conditions	a. Place all TCU "on-operate-off" switches into "operate" b. Insure that all "normal operation" transmitter simulation jumpers are still in place within the TCU's. c. Place all "maintenance-normal" switches (on appropriate MTB/ATB slot 19 connector cards) into "normal" position.	---
Response to Calls Entered through the Normal Telephone System (All Transmitters still Simulated at the Terminal)	a. Place the "busy-operate" switch associated with the first line interface set into "operate"; place the "busy-operate" switch associated with all remaining sets of the terminal into "busy". NOTE For redundant terminal configurations, "all remaining sets" includes line interface sets of both terminal halves taken together. b. Place a call to any paging subscriber number that has been validated. c. Place a call to any paging subscriber number that has not been validated. d. Repeat the above steps to check each data set for correct response (i.e. for each line interface set, in turn, place only the associated data set into "operate" while all remaining data sets are "busied out"--and observe that correct valid/invalid call response behavior is obtained.)	See Fig. 1-3 for Dial Input Sequence. See Fig. 1-5 for end to end sequence. (See Section 1 Instruction Manual) - Data set and TCU response appropriate to a valid call should occur.

Table 6-1. "Metro-Page" 10/100 Final Preoperational Checkout (Cont'd.)

ITEM	PROCEDURE	INDICATION
	IMPORTANT After testing, return all "busy-operate" switches to "operate" position.	
Terminal-Half Switch-over Check NOTE This step required only for redundant terminal configurations. Go directly to the next item when a non-redundant configuration is involved.	Set up: Place all "maintenance-normal" switches on the test side to "maintenance" position (located on appropriate MTB/ATB slot 19 connector cards). NOTE: Alarmed side CPU should continue operation. Perform the following within each terminal half, in turn. a. Place the major "on-disable-reset" switch of the alarm panel into its "reset" position to induce the major alarm/switchover condition. b. Enter a valid call through the terminal via the normal telephone system. c. Return the "on-disable-reset" switch to "on" and bring both terminal halves back "on-line". (See section II. paragraph 4 of the operating manual.) NOTE: After test return "maintenance-normal" switches to normal.	- Alarm panel's "major alarm" lamp lights - Redundant relays of the terminal half's redundant switchboard mounting panel--activate. - Observe that the call is correctly handled by a data set in the non-alarmed terminal half.
Paging Transmitter Cut-Over	Perform the following for each output path (non-redundant configuration); or for each associated output path pair (redundant terminal configuration) a. Remove the "normal operation" transmitter simulation strapping from the first TCU(s) associated with the output path(s). Leave the normal operation strapping present in all other TCUs. b. Enter a valid call to a subscriber whose service area will activate this (these) first TCU(s) (i.e., a subscriber whose group address is associated with an uncut jumper from among TCU jumpers JU0-JU15. NOTE Perform the following three steps for redundant terminal configurations, only. For non-redundant configurations, proceed directly to step f. c. Move the major "on-disable-reset" switch on the alarm panel of either terminal half to "reset" and repeat step b. (to thereby check that output redundancy switching/paging functions are properly operational).	- Observe (through TCU "xmit" lamp) that paging transmitter activates to send the page. - Observe that no alarm conditions occur. - Observe (through TCU "xmit" lamp that the paging transmitter associated with the non-alarmed terminal half activates to send the page.

Table 6-1. "Metro-Page" 10/100 Final Preoperational Checkout (Cont'd.)

ITEM	PROCEDURE	INDICATION
	d. Return the "on-disable-reset" switch to "on" and bring both terminal halves back "on-line" e. Repeat steps c. through d. for the opposite terminal half. f. Repeat steps a. through e. for each TCU (TCU pair) of all of the output path(s) used in the terminal **CAUTION** After testing insure that all transmitter simulation strapping has been removed from all TCUs. Simulation strapping accidentally left in place could prevent actual transmitter alarms from being reported.	- Observe that all paging transmitters can be activated by subscriber numbers directed to them and that no alarm conditions are generated.
Phase-Delay Adjustment (Where Required)		See Appendix for phase adjustments
Field Paging Tests	a. Place cap code of Test Pager in Test Buffer (see Operation Manual) for proper service area to be surveyed. Set cycle time to 60 sec. b. Move the pager to various locations within the coverage area and repeat the paging procedure. c. Repeat steps a. through b. for each different pager type used within the system and service area.	- In all cases, the page should be given by the pager (pagers) addressed.

NOTE

If difficulties are experienced with any of the preoperational checks or during any stages of commissioning, attempt to localize and correct the problem by referring to the trouble-shooting information given in the maintenance section of this manual.

6.1.3 Initialization

Step 1. Initialize remote terminals, if available, see FDS sheet TY page IV-44, Operating Manual.

Step 2. Enter initial subscriber base using CH command. This may be done through remote terminals also. (See FDS sheet CH page IV-6, Operating Manual.)

NOTE

Subscriber dumps should be done about every thousand entries until initial entry is complete.

Step 3. Perform a complete subscriber list dump. (See Operating Manual IV-22.)

Step 4. Perform a functional check of subscriber dump using FC command. (See Operating Manual page IV-19.)

Step 5. Verify that all User Functions (see Operating Manual page II-6, Table II-2) are operable from each remote Teletype.

Step 6. Having verified the preceeding, the remote Teletypes may now be moved to their final locations.

Step 7. The terminal should now be ready for in- service testing.

NOTE

Specific procedures may be necessary prior to in-service testing, when the terminal is to assume traffic from a pre- existing paging service.

"Metro-Page 100" Version 5 Program System Parameter Worksheet

Function Specified	Parameter Description	Parameter Value**	Manual Reference*
AR	PAGING AREA = Number of geographic transmitter groups. (Maximum number of paging areas is 16 per output unit.)		III-19 IV-2
SA	SERVICE AREAS = Logical coverage area of each individual subscriber which may be comprised of one or more paging areas. (Maximum number of service areas is 64.)		III-19 IV-30
US	USERS = Software division of the data base. (Maximum number of users is 15.)		III-19 IV-45

** Based on hardware and software requirements. Enter here for future reference.
* Refer to 68P81023C35 (Operating Manual).

— After Tape Loading —
Timer Parameter Worksheet

Function Specifier	Parameter Description: Input Timer Parameters	Timer Name	Timer (Mnemonic)	Standard Value	Parameter Value	Manual Reference
TM	Determines time limit allowed for entry of first data digit. For dial-pulse data sets, time is measured from the time the line is seized; for end-to-end data sets, time is measured from the end of the "go-ahead" tone.	Dial-Start	DG	5 sec	____ sec	IV-38 and IV-39 of Operating Manual
	Determines time limit or maximum time allowed to complete dialing of all remaining digits after the first digit is received.	Dial-Length	HL	15 sec	____ sec	
	Determines settling time — the minimum interval between receipt of last dialed digit and the sending of the ringback response.	Settling	DS	501 ms	____ ms	
	Determines ringback time — the minimum hold time necessary to assure billing, where applicable. The ringing tone is sent during this interval.	Ringback	RB	6 sec	____ sec	
	Determines billing time — the minimum time between the time the data set is seized and the time the "go- ahead" response is sent. It is the minimum hold time necessary to assure proper billing, where applicable.	Billing	BI	4 sec	____ sec	
	Determines go-ahead time — the length of time that the go-ahead response is presented.	Go-Ahead	GO	501 ms	____ ms ____ sec	
	Determines valid time — the length of time that the valid call response is presented.	Valid	VA	3 sec	____ sec	
	Determines invalid time — the length of time that the invalid-call response is presented.	Invalid	IV	10 sec	____ sec	
	Determines that portion of the end of an invalid response during which the tip and ring line connections are reversed. This reversal is needed to trigger disconnect at the end of the call at some central offices.	Mode-Flip	MF	501 ms	____ ms	
	Determines data set ready drop time. After the program tries to disconnect, this is the amount of time it should wait for the disconnect to be effected before assuming that an error has occurred.	Data Set Ready Drop	LD	30 sec	____ sec	
	Determines stabilization wait time. After the receipt of the disconnect signal, this is the amount of delay time that should be allowed before readying the data set for another call.	Stabilization-Wait	SZ	250 ms	____ ms	

Paging Area Worksheet
(See Operating Manual, Page IV-28)

Paging Area Number	Status	Type	Cycle Time	Duration Time	Unit #	TCU Addresses
1						
2						
3						
4						
5						
6						
7						
8						
9						
10						
11						
12						
13						
14						
15						
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						
31						
32						
33						
34						
35						
36						
37						
38						
39						
40						
41						
42						
43						
44						
45						
46						
47						
48						
49						
50						
51						
52						

Paging Area Worksheet
(See Operating Manual, Page IV-28 Cont'd.)

Paging Area Number	Status	Type	Cycle Time	Duration Time	Unit #	TCU Address
53						
54						
55						
56						
57						
58						
59						
60						
61						
62						
63						
64						

Service Area Worksheet (Version 5 Only)
(See Operating Manual, Page IV-30)

Service Area Number	Paging Areas	User Numbers
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
11		
12		
13		
14		
15		
16		
17		
18		
19		
20		
21		
22		
23		
24		
25		
26		
27		
28		
29		
30		
31		
32		
33		
34		
35		

Service Area Worksheet (Version 5 Only)
(See Operating Manual, Page IV-30 Cont'd.)

Service Area Number	Paging Areas	User Numbers
36		
37		
38		
39		
40		
41		
42		
43		
44		
45		
46		
47		
48		
49		
50		
51		
52		
53		
54		
55		
56		
57		
58		
59		
60		
61		
62		
63		
64		

User Worksheet
(See Operating Manual, Page IV-45)

User Number	Status	Number of Subscriber Memory Slots	Password (Up to Six Characters)
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			

Data Set Worksheet
"A" Side (See Operating Manual, Page IV-13)

Line Number	Status	Type	Offset	User Number	Trunk Group Number
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					

Data Set Worksheet
"B" Side (See Operating Manual, Page IV-13 Cont'd.)

Line Number	Status	Type	Offset	User Number	Trunk Group Number
53					
54					
55					
56					
57					
58					
59					
60					
61					
62					
63					
64					

Data Set Worksheet
"B" Side (See Operating Manual, Page IV-13)

Line Number	Status	Type	Offset	User Number	Trunk Group Number
1					
2					
3					
4					
5					
6					
7					
8					
9					
10					
11					
12					
13					
14					
15					
16					
17					
18					
19					
20					
21					
22					
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					
35					

Data Set Worksheet
"A" Side (See Operating Manual, Page IV-13 Cont'd.)

Line Number	Status	Type	Offset	User Number	Trunk Group Number
36					
37					
38					
39					
40					
41					
42					
43					
44					
45					
46					
47					
48					
49					
50					
51					
52					
53					
54					
55					
56					
57					
58					
59					
60					
61					
62					
63					
64					

Remote Terminal Worksheet
(See Operating Manual, Page IV-44)

Line Number	Status	Type	Rate	Users
1				
2				
3				
4				
5				
6				
7				
8				

Call Sign Worksheet For Output Unit _____

(See Operating Manual, Page IV-8)

TCU Address	Call Letters
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

Call Sign Worksheet For Output Unit _____

(See Operating Manual, Page IV-8)

TCU Address	Call Letters
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

Call Sign Worksheet For Output Unit _____

(See Operating Manual, Page IV-8)

TCU Address	Call Letters
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

Call Sign Worksheet For Output Unit _____

(See Operating Manual, Page IV-8)

TCU Address	Call Letters
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

Call Sign Worksheet For Output Unit _____

(See Operating Manual, Page IV-8)

TCU Address	Call Letters
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

Call Sign Worksheet For Output Unit _____

(See Operating Manual, Page IV-8)

TCU Address	Call Letters
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
11	
12	
13	
14	
15	

Subscriber Table Directory Worksheet For User

(See Operating Manual IV-11)

CAUTION

Directory changes cause corresponding changes in the subscriber numbering system for the user. Extreme care must be taken when specifying new subscriber number directory groupings so that existing numbering of active subscribers is left unchanged. Failure to insure this will cause existing subscriber information to be assigned to different subscriber numbers. For example, a user who has 10,000 subscriber slots allocated with the first 3000 having active subscriber information, MUST NOT interfere with the directory specification for those 3000 subscriber slots. If a directory change is made, the user must re-enter the specifications of those 3000 subscriber slots EXACTLY as they appear upon display. Once past the slots containing active subscribers, the user may make the desired changes. To make certain that changes to directory ranges have not caused unwanted subscriber numbering changes, the user should spot check active subscriber numbers for proper data content through the LI function.

EXAMPLE:

The following example shows how a new directory is established for a user with 10048 subscriber slots, initially all single function. The first 5000 subscriber numbers are left single function.

The next 5000 numbers are specified as dual function numbers (using only 2500 subscriber slots). The remaining slots are given a single function designation.

0DI:SP(CR)
000000 — 010047/01
000000 — 4999/1(CR)
005000 — 010047/01
005000 — 9999/2(CR)
010000 — 012547/01
010000 — 12547/1(CR)
000000 — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___

Subscriber Table Directory Worksheet For User

(See Operating Manual IV-11)

CAUTION

Directory changes cause corresponding changes in the subscriber numbering system for the user. Extreme care must be taken when specifying new subscriber number directory groupings so that existing numbering of active subscribers is left unchanged. Failure to insure this will cause existing subscriber information to be assigned to different subscriber numbers. For example, a user who has 10,000 subscriber slots allocated with the first 3000 having active subscriber information, MUST NOT interfere with the directory specification for those 3000 subscriber slots. If a directory change is made, the user must re-enter the specifications of those 3000 subscriber slots EXACTLY as they appear upon display. Once past the slots containing active subscribers, the user may make the desired changes. To make certain that changes to directory ranges have not caused unwanted subscriber numbering changes, the user should spot check active subscriber numbers for proper data content through the LI function.

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The next 5000 numbers are specified as dual function numbers (using only 2500 subscriber slots). The remaining slots are given a single function designation.

0DI:SP(CR)
000000 — 010047/01
000000 — 4999/1(CR)
005000 — 010047/01
005000 — 9999/2(CR)
010000 — 012547/01
010000 — 12547/1(CR)
000000 — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___

Subscriber Table Directory Worksheet For User

(See Operating Manual IV-11)

CAUTION

Directory changes cause corresponding changes in the subscriber numbering system for the user. Extreme care must be taken when specifying new subscriber number directory groupings so that existing numbering of active subscribers is left unchanged. Failure to insure this will cause existing subscriber information to be assigned to different subscriber numbers. For example, a user who has 10,000 subscriber slots allocated with the first 3000 having active subscriber information, MUST NOT interfere with the directory specification for those 3000 subscriber slots. If a directory change is made, the user must re-enter the specifications of those 3000 subscriber slots EXACTLY as they appear upon display. Once past the slots containing active subscribers, the user may make the desired changes. To make certain that changes to directory ranges have not caused unwanted subscriber numbering changes, the user should spot check active subscriber numbers for proper data content through the LI function.

EXAMPLE:

The following example shows how a new directory is established for a user with 10048 subscriber slots, initially all single function. The first 5000 subscriber numbers are left single function.

The next 5000 numbers are specified as dual function numbers (using only 2500 subscriber slots). The remaining slots are given a single function designation.

0DI:SP(CR)
000000 — 010047/01
000000 — 4999/1(CR)
005000 — 010047/01
005000 — 9999/2(CR)
010000 — 012547/01
010000 — 12547/1(CR)
000000 — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___

Subscriber Table Directory Worksheet For User

(See Operating Manual IV-11)

CAUTION

Directory changes cause corresponding changes in the subscriber numbering system for the user. Extreme care must be taken when specifying new subscriber number directory groupings so that existing numbering of active subscribers is left unchanged. Failure to insure this will cause existing subscriber information to be assigned to different subscriber numbers. For example, a user who has 10,000 subscriber slots allocated with the first 3000 having active subscriber information, MUST NOT interfere with the directory specification for those 3000 subscriber slots. If a directory change is made, the user must re-enter the specifications of those 3000 subscriber slots EXACTLY as they appear upon display. Once past the slots containing active subscribers, the user may make the desired changes. To make certain that changes to directory ranges have not caused unwanted subscriber numbering changes, the user should spot check active subscriber numbers for proper data content through the LI function.

EXAMPLE:

The following example shows how a new directory is established for a user with 10048 subscriber slots, initially all single function. The first 5000 subscriber numbers are left single function.

The next 5000 numbers are specified as dual function numbers (using only 2500 subscriber slots). The remaining slots are given a single function designation.

0DI:SP(CR)
000000 — 010047/01
000000 — 4999/1(CR)
005000 — 010047/01
005000 — 9999/2(CR)
010000 — 012547/01
010000 — 12547/1(CR)
000000 — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___

Subscriber Table Directory Worksheet For User _____

(See Operating Manual IV-11)

CAUTION

Directory changes cause corresponding changes in the subscriber numbering system for the user. Extreme care must be taken when specifying new subscriber number directory groupings so that existing numbering of active subscribers is left unchanged. Failure to insure this will cause existing subscriber information to be assigned to different subscriber numbers. For example, a user who has 10,000 subscriber slots allocated with the first 3000 having active subscriber information, MUST NOT interfere with the directory specification for those 3000 subscriber slots. If a directory change is made, the user must re-enter the specifications of those 3000 subscriber slots EXACTLY as they appear upon display. Once past the slots containing active subscribers, the user may make the desired changes. To make certain that changes to directory ranges have not caused unwanted subscriber numbering changes, the user should spot check active subscriber numbers for proper data content through the LI function.

EXAMPLE:

The following example shows how a new directory is established for a user with 10048 subscriber slots, initially all single function. The first 5000 subscriber numbers are left single function.

The next 5000 numbers are specified as dual function numbers (using only 2500 subscriber slots). The remaining slots are given a single function designation.

0DI:SP(CR)
000000 — 010047/01
000000 — 4999/1(CR)
005000 — 010047/01
005000 — 9999/2(CR)
010000 — 012547/01
010000 — 12547/1(CR)
000000 — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___

Subscriber Table Directory Worksheet For User

(See Operating Manual IV-11)

CAUTION

Directory changes cause corresponding changes in the subscriber numbering system for the user. Extreme care must be taken when specifying new subscriber number directory groupings so that existing numbering of active subscribers is left unchanged. Failure to insure this will cause existing subscriber information to be assigned to different subscriber numbers. For example, a user who has 10,000 subscriber slots allocated with the first 3000 having active subscriber information, MUST NOT interfere with the directory specification for those 3000 subscriber slots. If a directory change is made, the user must re-enter the specifications of those 3000 subscriber slots EXACTLY as they appear upon display. Once past the slots containing active subscribers, the user may make the desired changes. To make certain that changes to directory ranges have not caused unwanted subscriber numbering changes, the user should spot check active subscriber numbers for proper data content through the LI function.

EXAMPLE:

The following example shows how a new directory is established for a user with 10048 subscriber slots, initially all single function. The first 5000 subscriber numbers are left single function.

The next 5000 numbers are specified as dual function numbers (using only 2500 subscriber slots). The remaining slots are given a single function designation.

0DI:SP(CR)
000000 — 010047/01
000000 — 4999/1(CR)
005000 — 010047/01
005000 — 9999/2(CR)
010000 — 012547/01
010000 — 12547/1(CR)
000000 — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
_____ — _____ / ___
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Subscriber Table Directory Worksheet For User _____

(See Operating Manual IV-11)

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7. MAINTENANCE

7.1 INTRODUCTION

This manual section provides information relating to maintaining and troubleshooting the paging system.

NOTE

Troubleshooting and maintenance procedures for the computer equipment, announcement recorders, and power supplies are contained in separate manufacturer's manuals.

7.2 REPAIR PRACTICES

7.2.1 Replacement Parts

When damaged components must be replaced, identical parts should be used. If an exact replacement is not available locally, check the parts list of the unit involved for the Motorola part number and order the component from the nearest Motorola Replacement Parts Depot. If, for any reason, substitutions must be made, replace these components as soon as the proper part becomes available. The substituted part must have the same electrical properties as the part to be replaced, and equal or higher operating voltage and power ratings.

7.2.2 Location

Relocation of a substituted part may cause problems and is not recommended. Mount the new or repaired part in the same position or mounting as that formerly occupied by the damaged part.

7.2.3 Soldering

Before soldering any connections, carefully scrape all parts to be soldered until all traces of rust, corrosion, paint or varnish are removed. Dust the scraped parts with a small clean brush. Tin all surfaces to be soldered. Wrap the wire around the lug to be soldered to obtain sufficient mechanical support (if applicable). Solder the connection, using a minimum amount of solder with sufficient heat to make the solder flow evenly around the tinned surface.

7.2.4 Printed Circuit Repair Techniques

7.2.4.1 Construction

All components used in this system are mounted on the printed circuit board. The board is the etched-copper type with plated-through holes. This type of board is superior to the metal-foil plated type due to the binding properties of the copper plating to the glass epoxy board.

Early printed circuit board repair techniques stressed the use of low wattage soldering tools to prevent board damage when components were removed. Experience has shown that the low wattage iron may actually cause printed circuit damage. A considerable amount of time is usually required to heat a connection to the melting point with a low wattage iron. During this time, heat is conducted away from the connection along the printed wiring. This conducted heat may separate the printed wiring from the board or damage nearby solder connections. A medium-wattage soldering iron (approximately 50 watts) is recommended for a printed circuit repair. This iron should have a temperature-controlled tip to prevent excessive heating and increase tip life. The ST-1087 Soldering Station (Figure 7-1a), with an 800-degree tip, is an excellent choice for printed circuit work.

Clearing circuit board holes of excess solder with a pick, as formerly recommended for some Motorola products, has been shown to cause damage to the plating in and around the hole when excessive zeal is used in applying this technique. In order to prevent this occurrence, clear holes only by solder extraction. Use the ST-1163 Precista Vacuum Desolder Pump to extract molten solder. For large repair facilities, in which a volume of printed circuit boards are to be processed, consider the RSX-1002A Desoldering Station (Figure 7- 1b). This latter device is especially useful in removing IC's.

Breaks in the printed circuit wiring can be repaired by bridging the gap with solder. Remove the resin coating on the printed wiring with solvent before soldering. Printed wiring that cannot be practically repaired with a solder bridge can be replaced with a piece of hook-up wire. Route the hook-up wire along the original path of the printed circuit to avoid any lead dressing problems in critical areas.

7.2.4.2 Component Removal

Use special care during troubleshooting to be as certain as possible that the suspected component is the faulty one. This special care eliminates unnecessary unsoldering and removal of parts which may weaken or damage the circuit board.

When removing resistors, capacitors and similar components, heat the connection to be loosened until the solder is molten. Then brush away, or shake off as much of the molten solder as possible. If the leads are bent over, use a soldering aid tool or a knife to straighten them. It may be necessary to apply the soldering iron while doing this. While applying the soldering iron, wiggle the component gently to free it, then lift it from the board. Be sure the component lead is free before trying to remove it or the circuit board might be damaged. Install the new component and solder it in place. Use solvent to remove excess flux after soldering.

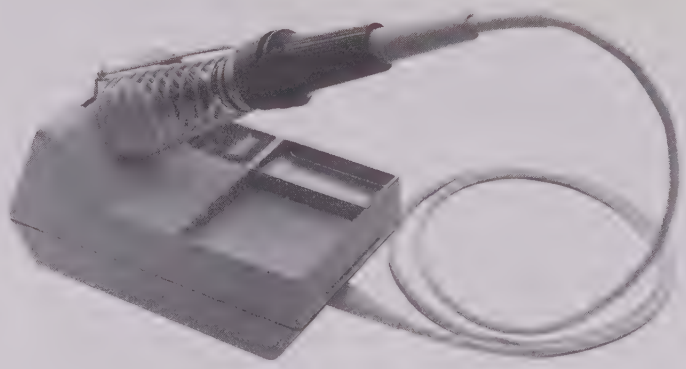


Figure 7-1a. Type ST-1087 Soldering Station

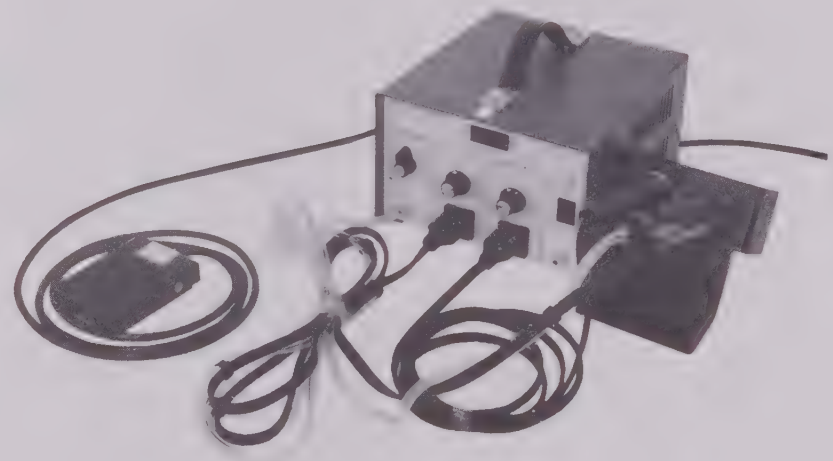


Figure 7-1b. Type RSX-1002A Desoldering Station

7.2.4.3 Servicing Aids

An adequate concentration of light and magnification aids service by enabling visual examination of connections and miniature parts. The ST-652 Magnifying Glass and Built-In Light Source (Figure 7-2) is a desirable tool for servicing miniature equipment in the shop. The large illuminated magnifying glass makes it easy to see any portion of the small component found on the printed circuit board.

Figure 7-2. Type ST-652 Magnifying Glass

Figure 7-3 illustrates general hand tools needed for work on printed circuitry and miniature components.

IMPORTANT

The NLN8883A Binary Output Board and the SP570306103 DFDD Coder Board which may be used within "Metro-Page" 10/100 terminals both utilize complimentary metal oxide semiconductor (CMOS) devices (integrated circuits within the MC14000 Series; MC14500 Series; and RCA CD4000 series). The following handling precautions are applicable to these devices -- especially in cold/dry climates:

1. All MOS devices should be stored or transported in conductive material so that all exposed leads are shorted together. MOS devices must not be inserted into conventional plastic "snow" or plastic trays of the type used for storage and transportation of other semiconductor devices.
2. All MOS devices should be placed on a grounded bench surface and the technicians should ground themselves prior to handling devices. This is done most effectively by having the technician wear a conductive wrist strap in series with 100k to ground.
3. Nylon clothing should not be worn while handling MOS circuits.
4. Do not insert or remove MOS devices with power applied. Check all power supplies to be used for testing MOS devices and be certain there are no voltage transients present.
5. When lead straightening, provide ground straps for the apparatus used.
6. When soldering, use a grounded soldering iron.
7. All power should be turned off in a system before printed circuit boards containing MOS devices are inserted or removed.
8. All printed circuit boards containing MOS devices should be provided with shorting straps across the edge connector when being carried or transported.
9. MOS devices should be handled by their packages and not by the leads, if at all possible. Prior to touching the unit, the technician should touch an electrical ground to remove any static charge that may have been accumulated. The package and substrate may be electrically common. If so, the reaction of a discharge to the case would cause the same damage as touching the leads.

7.2.5 Wire-Wrapping Techniques

Wire-wrapping procedures are included to define the materials and processes recommended for making or changing electrical connections in the terminal. Refer to Figure 7-4 to become familiar with the terminology used in describing wire-wrapping procedures.

7.2.5.1 Equipment Required

The following guns are recommended for use in wire-wrapping solid or stranded wire.

Hand-Squeeze Gun, Gardner-Denver Model 14H-1C (or equivalent).

Battery Operated Gun, Gardner-Denver Model 14R2 (or equivalent).

Air-Operated Gun, Standard Pneumatic Model 663 (or equivalent).

NOTE

The hand-squeeze type gun should not be used for wrapping wire smaller than AWG28. Battery-powered or air-operated guns can be used for wrapping wire sizes AWG22 through AWG 30.

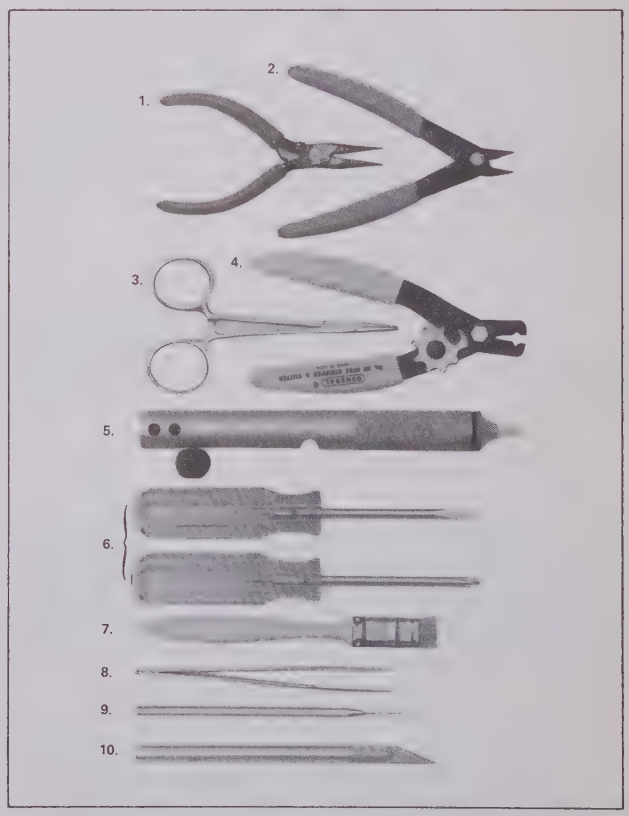


Figure 7-3. Type ST-639 Printed Circuit Repair Kit

Table 7-1. Wire-Wrap Bits and Sleeves (Gardner-Denver Part Numbers)

Wire Gauge	Wire Diameter in Inches	Solid Wire	
		Bit #	Sleeve #
30	0.0100	507063	507100
26	0.015	502118	512056
24	0.02	26263	18840

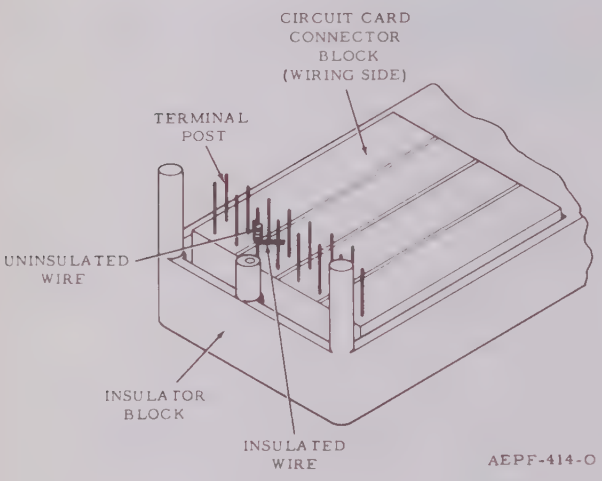


Figure 7-4. Wire-Wrap Terminology

The use of ac electric-powered wire-wrap guns is not recommended on "Metro-Page" 10/100 equipment. If guns of this type must be used, care must be taken to eliminate cut or crimped wire and torn insulation, otherwise malfunctions causing erratic operation of the terminal will result.

7.2.5.2 Wire-Wrap Bits and Sleeves

The wire-wrap bits and sleeves listed in Table 7-1 are manufactured by Gardner-Denver Inc. and are used for wrapping sizes AWG 24 through AWG 30 solid wire.

7.2.5.3 Basic Techniques

The modified wrapped connection is the only acceptable wire wrap technique used to make connections in the terminal. This connection requires a minimum half turn of insulated wire to be wrapped around the terminal post to improve vibration characteristics (see Figure 7-5).

Additional turns of stripped wire are required to make the electrical connection. One turn of wire is one complete helical ring of stripped wire wrapped around the terminal post. Table 7-2 specifies the number of turns required for each gauge of wire and Figure 7-5 illustrates the method of counting the number of wire wrap turns in the modified wrapped

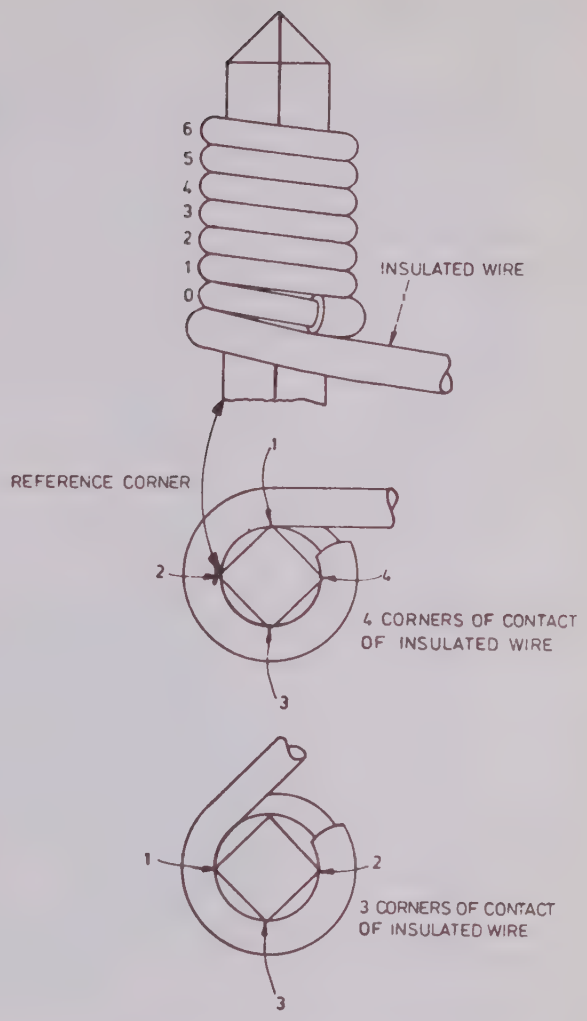


Figure 7-5. Wire Wrapped Connections

connection. Observe in Figure 7-5 that the single turn of insulated wire is not included when counting the total turns of a wire wrapped connection. The number of turns is determined by the number of times the wire passes then subsequentially intercepts the reference edge of the terminal post after the first intercept of the uninsulated wire at the reference edge.

7.2.5.4 Wire Preparation

The wire end to be wrapped should be stripped of insulation to the length specified in Table 7-2.

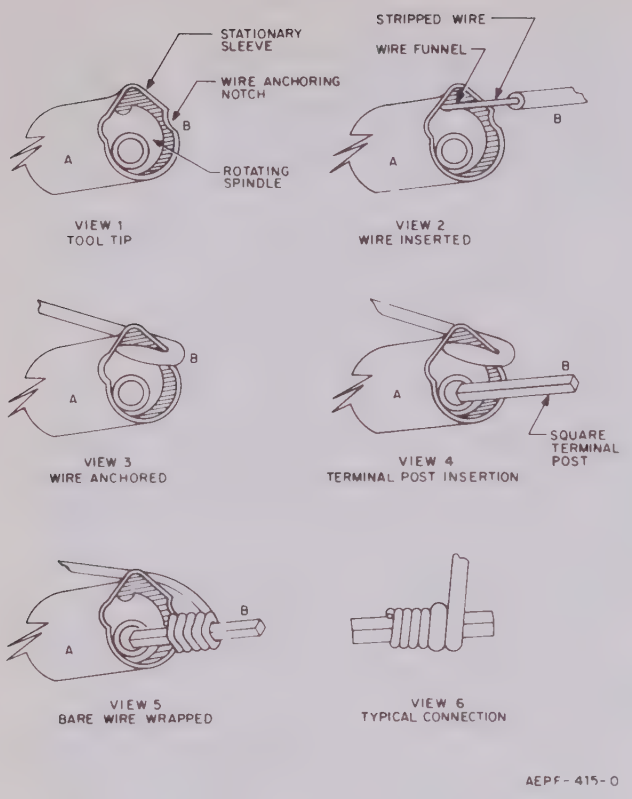


Figure 7-6. Wire-Wrapping Procedures

Table 7-2. Wire Stripping Lengths

Wire Gauge	Strip Length in Inches	
	Minimum	Maximum
30	6/8	1
26	1-7/16	1-11/16
24	1-1/8	1-7/16

7.2.5.5 Wrapping Solid Wire (Refer to Figure 7-6)

Solid wire-wrapped connections should be made as follows:

Step 1. Insert the stripped end of the wire into the wrapping tool funnel (refer to Figure 7-6, view 2). Insulated portions of the wire should be inserted positively to the foot of the covered part of the wire.

Step 2. Bend the wire through notch B in the wire-wrap sleeve (refer to Figure 7-6, view 3).

Step 3. Place the spindle hole in the bit over the terminal to be wrapped (refer to Figure 7-6, view 4).

Step 4. Position the wire-wrap gun so that the wire leaves the terminal in a direction that does not tend to cause unwrapping after the terminations of both wire ends have been made.

Step 5. Squeeze the trigger on the wire-wrap gun and allow the wrap to be completed(refer to Figure 7-6, views 5 and 6).

Step 6. Check the connection. Be sure the number of turns is within the specifications shown in Table 7-3.

7.2.5.6 Wrapping Defects

After completion of a wire wrapped connection verify that none of the following defects are present.

- Insufficient turns.
- Loose wrapping.
- Non-uniform turns, which usually are spiral wraps, open wraps or over wraps. These defects are illustrated in Figure 7-7.

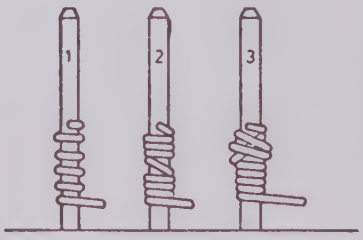


Figure 7-7. Non-Uniform Wire Wrap Turns

The spiral wrap is caused by not enough pressure on the wrap bit, an open wrap is caused by uneven pressure on the wrap bit and the over wrap is caused by a faulty wrap bit or excessive pressure on the wrap bit.

- Damaged wire caused during stripping or wrapping.
- Damaged connection caused by an accidential blow from an adjacent wrapping operation.
- Insulation defects, such as insulation creepage, split insulation or non-uniformity of the insulation around the central conductor.

Table 7-3. Recommended Wire-Wrapping Parameters (Solid Wire)

Wire Gauge	Number of Turns	
	Minimum	Maximum
30	7	9
26	6	7
24	5	6

7.3 PERIODIC MAINTENANCE CHECKS/PROCEDURES

The checks and procedures included in this section should be performed as prescribed in Table 7-4 Periodic Maintenance Chart to ensure that the paging terminal equipment is maintained in top operating condition.

The following test equipment is recommended for carrying out these procedures:

- Oscilloscope - Tektronics type 465 or equivalent
- Volt-Ohmmeter - Simpson Model 260 or equivalent
- AC Voltmeter - Motorola Model S1053C or equivalent
- Digital Voltmeter - Hewlett Packard Model 3469B or equivalent.

CAUTION

Once a redundant terminal configuration has been placed into operation, any interruption in a particular terminal half necessitates that this terminal half including its CPU be "restarted" by following the restart procedures described in para. 7-5 of this section.

Failure to start in the prescribed manner may result in lost pages and incorrect traffic data.

7.3.1 Mechanical Inspection

Step 1. Check that the plastic foam air filters on top of each cabinet are in position and clean.

Step 2. With cabinet side panels removed, verify that fans and air passages on sides of computer and accessory drawers are clear of dust and lint.

Step 3. Verify that system cables and external cables entering the cabinets are dressed neatly and tied down where needed.

Step 4. Make certain that an adequate ac power circuit is being maintained to the terminal. No other devices or systems should be attached to this circuit.

Step 5. Verify that all the ac line cords in the rear of the terminal cabinets are plugged into the appropriate ac distribution panels.

Step 6. Verify that all the cable terminator cards connecting system cables to each master or auxiliary terminal block (MTB/ATB) in the rear of the cabinet are firmly and squarely seated in the appropriate connectors. Look for any broken or loose wires on these cards.

Step 7. Verify that all the printed circuit boards in the system alarm panel rack(s) are firmly seated in the appropriate connectors.

Step 8. Verify that the printed circuit boards in the system input test panel rack are firmly seated in the appropriate connectors.

Step 9. Verify that all the input data set boards are properly seated in the appropriate connectors.

Step 10. Verify that all transmitter control unit boards are properly seated in the appropriate connectors.

Step 11. Verify that the 3-amp grasshopper fuses (blue tab) are inserted in the fuseholders under each input data set in the system and that none of these fuses are blown.

Step 12. Check all front panel lamps (including computer lamps). Replace burned out lamps.

7.3.2 Power Supply Checks/Adjustments

7.3.2.1 Basic Adjustments

Check and adjust the basic power supply levels as summarized in Table 7-5. (Perform separately within each terminal half for redundant terminal configurations.)

7.3.2.2 Overvoltage Protector Adjustment Procedure

To check or adjust the over-voltage-protection point of an over-voltage protector used on a 110 V ac or 240 V ac power supply system, proceed as follows:

Step 1. Halt the processor, then turn off all power supply systems which contain the over-voltage protectors to be adjusted.

Step 2. Remove the power control cables from their connector 19 slot(s) (MTB plus all ATB's having a power control cable in slot 19).

Step 3. Adjust each over-voltage protector as shown in Table 7-5.

Step 4. Turn on power supply associated with the overvoltage protector and raise output voltage to the normal operating voltage, taking care to monitor the power supply output voltage.

Step 5. Slowly turn the voltage adjust control of the over-voltage protector counterclockwise until the power supply voltage, as indicated by the monitor, drops suddenly.

Step 6. For an LMOV-1 (+5 V) protector, rotate the voltage adjust control CLOCKWISE by 5.8 turns; for an LMOV-2 (+12 V), rotate CLOCKWISE by 3.5 turns. (This sets the over-voltage protection point at an optimum value of 15% above nominal supply voltage.)

Step 7. With voltage adjustment complete, momentarily remove input power to the supply so that the over-voltage protector will reset.

Step 8. After adjustment of the over-voltage protectors turn off power supply; reinsert the power control cables into connector 19 MTB/ATB slot(s); turn on power supply; and restart the CPU following the "restart procedures after CPU halt" instructions.

Table 7-4. "Metro-Page" 10/100 Periodic Maintenance Chart

Item Performed	When Performed*	Procedure
Mechanical Inspection	I; E; AR; every 3 months **NOTE** In extremely dustry environments, perform air filter, fan, and air passage checks at more frequent intervals.	See paragraph 7.3.1.
Power Supply Checks/Adjustments	I; E; every 3 months	See paragraph 7.3.2.
Room Temperature/Humidity Check	Every week	Measure room temperature and humidity value and ascertain that values are within prescribed specification.
Paper-Tape Reader/Punch	Every 600 hours or four months	Perform the operations detailed in the DEC Manual, page 5-1, paragraph 5.2; and in the Roytron manual, page PM5-2 through PM5-7.
DECwriter	Periodically	Cleaning is only required; see Operator Care, page 3-19, DECwriter Manual.
Magnetic Tape Unit (if used)	Once/shift; weekly; Monthly (See DEC Manual)	Cleaning procedures are detailed in Table 4-1, page 4-3 of the DEC Magtape user's manual.
Core Memory	Every three months	Several maintenance operations are detailed including the DEC diagnostic tape procedures. See DEC core memory manual paragraph 5.3, page 5-7.
Disc Memory (if used)	Every three months	Run DEC diagnostic tapes. Refer to DEC documentation and DDC documentation. **NOTE** If disc unit is operated in an unclean or corrosive environment the inert gas atmosphere under the cover must be replaced at six month intervals. (See DDC maintenance manual, Section IV.)
Diagnostics	Every three months	Run DEC/X11 (see Section 7.6 for details). Modules selected: • RFAG0 • KWAG0 • CPAG0 Test should run a minimum of four hours per system half. **NOTE** Test should be run on only one half at a time. If TM-11 is used, *remove* load medium and load scratch tape before starting tests, as it will read/write to the TM-11.

I = At time of initial installation
E = At time of system expansion
AR = After repairs

Table 7-5. Power Supply Voltage Check/Adjustment Chart

Power Supply Voltage Level	Monitoring Points	Acceptable Range (V)	Adjustment
+5 V (from basic power supply system PS1)	MTB19-1 (+) and MTB19-Z (GND)	5.25 to 5.35	Potentiometer on +5 V supply unit of PS1. Pot located on side of unit opposite unit's connection terminals; pot accessible from front of terminal with long blade screwdriver.
+5 V (from basic power supply system PS2 and up)	ATB2 19-1 (+) and ATB2 19-Z (GND)	5.25 to 5.35	As above, but for PS2, etc.
+12 V (unswitched) from PS1	MTB 19-8 (+) and MTB 19-Z (GND)	12.0 to 12.5	Potentiometer on +12 V supply unit of PS1. Pot located on side of unit opposite unit's connection terminals; pot accessible from front of terminal with long blade screwdriver.
+12 V (unswitched) from PS2 and up	ATB2 19-8 (+) and ATB2 19-Z (GND)	12.0 to 12.5	As above, but for PS2, etc.
-48 V	MTB 1-17 (-) and MTB 1-V (GND)		(Customer Supplied Power Source)
+5 V, -15 V (from DEC H720F accessory drawer power supply)	(See Detailed Check/Adjust Procedure described in paragraph 7.3.2.)		

7.3.2.3 Adjustment of Accessory Drawer Power Supply DEC Models 720E/H720F

NOTE

To prevent erratic terminal operation, it is important to perform the following procedure for each accessory drawer power supply once every three months and after system expansions.

Step 1. Insure that each power supply's load at 5 V does not exceed 22A. The load may be calculated from the following data:

5V Power Used from DEC Accessory Drawer Power Supply

Item	Current (A)
Input Unit	3.7
Old Five-Tone Output Unit	3.3
DFDD Output Unit	5.3
Binary Output Unit	1.2
Unibus Terminator	1.2
DB11 Unibus Repeater	3.2
DC11 System Unit (with both DC11-DA card sets)	4.4
DR11-C Data Transfer Module (each)	1.5
PC11 Reader Punch Interface Card	1.5

Step 2. Expose the plug-in card area of the drawer containing the power supply being adjusted. Disconnect incoming and outgoing Unibus cables and put a Unibus Terminator card into the last system unit of the drawer.

Step 3. Using the digital voltmeter, observe the +5 V supply at the point furthest from the power supply. (That point is usually pin F1A2 on the system unit closest to the front of the accessory drawer. Connect the voltmeter ground lead to an adjacent ground clip on the system unit.)

Step 4. Adjust the 5 V potentiometer in the power supply (usually the pot closest to the rear of the accessory drawer on the regulator board — check the H720 manual for exact location) so that the voltage measured in Step 3 above is 5.00 V.

Step 5. Having set the +5 V supply, next set the -15 V supply per the following instructions.

Step 6. Connect an oscilloscope to display the "DC LO" signal on pin B1F2 or B4F2 of any system unit in the drawer containing the power supply being adjusted.

Step 7. Connect a digital voltmeter to the -15 V supply within the power supply, or on pin A3A1 of the first system unit, and temporarily adjust to to -15.0 V using the -15 V potentiometer in the supply (usually closest to the front -- refer to DEC documentation for exact location).

Step 8. Observe the oscilloscope display and turn the -15 V adjusting pot counterclockwise until the DC LO signal voltage begins to decay from the normal 5.0 V (the voltage will change from a fairly smooth 5.0 V level to a jagged, sawtooth waveform).

Step 9. Counting the turns, rotate the -15 V adjustment clockwise. The oscilloscope display will return to a level 5.0 V signal and, as rotation continues, will show a jagged appearance as in Step 8 above. At the appearance of the jagged waveshape, stop rotating the control clockwise, divide the number of turns by two, and rotate the pot counterclockwise by that amount in order to center the pot between the two points at which DC LO becomes jagged.

Step 10. This completes the power supply adjustment procedure. Do not be concerned if the -15 V supply now measures slightly low or high.

7.4 TROUBLESHOOTING

7.4.1 General

When difficulties are experienced with the paging terminal, the following steps performed in the order shown will facilitate the localization/troubleshooting process.

7.4.1.1 Where Telephone Company Central Office "Busy-Out" Signalling is Provided

7.4.1.1.1 Redundant Terminal Configurations

Place the major "on-disable-reset" switch located on the alarm panel of the terminal half experiencing the difficulties--into its reset position. This will "busy-out" all switched data sets in that terminal half (placing them "off-line") while troubleshooting is being performed. "Busy-out" all non-switched data sets by placing the corresponding "busy-operate" switches (on input data set fuse panels) into the "busy" position.

Also place the "maintenance-normal" switch of every power control cable board (slot 19 in MTB and in even-numbered ATB's) into its "maintenance" position. This will insure that during troubleshooting, +12 V is maintained to all data sets and that system major alarm reporting will be inhibited.

7.4.1.1.2 Non-Redundant Terminal Configurations

Place all individual "busy-operate" switches (on input data set fuse panels) into the "busy" position to insure that the terminal provides a "busy" indication to all incoming calls.

Also place the "maintenance-normal" switch of every power control cable board (slot 19 in MTB and in even-numbered ATB's) into its "maintenance" position. This will insure that during troubleshooting, +12 V is maintained to all data sets and that system major alarm reporting will be inhibited.

7.4.1.2 Carry Out a Good "Visual Inspection" of the Equipment:

- AC power reaching all terminal subcomponents?
- Fuses good?
- All printed circuit connector cards firmly seated in their proper connectors?
- Inter-terminal cables properly connected?
- All telephone input and other input/output lines properly connected?

7.4.1.3 Localize the Difficulty--Referring, as Required, to the Following Items:

- Troubleshooting Charts presented in this section.
- Subsystem Checkout Procedures (described in the installation section).
- Wiring diagrams/lists; schematics, block diagrams, timing diagrams--for signal tracing.
- Theory of operation descriptions of correct behavior (theory of operation section).
- Error message printouts.
- Alarm panel indicators chart.

7.4.1.4 Correct the Malfunction

Replace a faulty module in its entirety with a working module, or repair the faulty module.

7.4.1.5 Bring the Repaired Terminal/Terminal-Half Back on Line

- Insure that any items removed or modified for repair are restored to their correct positions and original conditions.
- Return the "on-disable-reset" switch to "on;" return all "maintenance-normal" switches to "normal."
- Restart the terminal/terminal-half by following the appropriate system restart procedure given in the following paragraph 7.5.

7.4.2 Error Condition Messages

Refer to the Error Message Chart, Table 7-6 to find the correct entry point into the Troubleshooting Flow Charts, paragraph e. Error condition messages are one-line or two-line messages having the following format:

NN-DD	HH:MM	ID	MESSAGE (line 1)
WORD 1	WORD 2		(line 2)

where:

NN-DD = date (month-day)
HH:MM = time (hour:minute)
ID = a letter-number combination used as a convenient message shorthand symbol
MESSAGE = plain language text indicating the nature of the error condition
WORD 1 = first six-octal-digit word concerning address/unit involved
WORD 2 = second six-octal-digit word concerning address/unit involved

The following listings provides interpretation/cause information concerning the above error messages:

I10: The interrupt sequence from the line interface set (LIS) indicated by xx is not occurring in the correct order. Normal sequence of operation is to receive a ring interrupt; one or more data interrupts; and, finally, a data set ready drop (DSRD) interrupt. Any sequence other than above will cause the alarm.

I11: Computer responds to an apparent interrupt from the specified 8-LIS group, but after polling all eight registers of this group finds no interrupting input register.

I12: LIS input line receiver detects a second dial digit before the first has been accepted by the computer. This causes loss of the first dial digit and application of the invalid signal (NU tone) to the incoming telephone line.

I13: LIS xx submitted an invalid data digit value to the computer. This value is inconsistent with any possible caller-entered dialed digit.

Possible causes:

- Improper number of dial pulses received from telephone line trunk.
- Inter-digit time too short on input logic board.

I14: Computer failed to receive data set ready drop (DSRD) interrupt within the time specified by LD in the software timers, after the end of LIS xx's call processing procedure. See Operating Manual FDS-TM for timer description.

Possible causes:

- Central office (switching center) equipment has not responded to end-of call SLEEVE lead signalling from the data set.
- Faulty input data set card/cards.

I15: When the teletypewriter command to place an input data set out of service was issued, the input was busy. Rather than interrupt the call, the computer waits until the unit is free, places the data set out of service, and notifies the operator with this message.

01: One or more transmitters associated with addressed TCU's have failed to turn on properly,

Table 7-6. Error Condition Messages-STD100 Software

NOTE
I1, I2, & I3 error print outs not used, see SP manual.

Message No.	Error Message	Word #1	Word #2	Reference Notes
I10	Invalid interrupt sequence, line xx	Address of offending register	Contents of status register	See System Troubleshooting Flow Chart Entry Point "D."
I11	Spurious interrupt sequence, line XX	Address of the last register of the offending shelf	N/A	If highly repetitive, see System Troubleshooting Flow Chart Entry Point "D."
I12	Data lost, line xx	Address of offending register	Contents of control register	See System Troubleshooting Flow Chart Entry Pont "D."
I13	Data error, line xx	Address of offending register	Contents of data register masked to show data received	See System Troubleshooting Flow Chart Entry Point "D."
I14	DSRD failure, line xx	Address of offending register	N/A	See System Troubleshooting Flow Chart Entry Point "D."
01	Minor TCU alarm, unit xx	Address of STR of output unit	Contents of STR of output unit	See TCU, Troubleshooting Chart.
02	Major TCU alarm, unit xx	Address of STR of output unit	Contents of STR of output unit	See System Troubleshooting Flow Chart Entry Point "J."
03	No page complete, unit xx	Address of STR of output unit	Contents of STR of output unit	See System Troubleshooting Flow Chart Entry Point "J."
04	No ASI complete, unit xx	Address of output unit	N/A	See System Troubleshooting Flow Chart Entry Point "J."
05-07	See applicable SP manual	—	—	—
08	Page limit exceeded, unit xx	Address of STR of output unit	N/A	This print-out necessitates system expansion.
S1	Disc error	Address of DCS register	Contents of DCS register	See OEM manuals for disc system.
S2	Spurious input interrupt, remote TTY xx	Address of RCSR of the remote TTY interface	Contents of RCSR of the remote TTY interface	See System Troubleshooting Flow Chart Entry Point "C." See OEM manuals for the appropriate device.
S3	Spurious output interrupt, remote TTY xx	Address of RCSR of the remote TTY interface	Contents of RCSR of the remote TTY interface	See System Troubleshooting Flow Chart Entry Point "C." See OEM manuals for the appropriate device.
S10	Comm link data fault	Address of DRCSR of system half's DR-11C	N/A	See System Troubleshooting Flow Chart Entry Point "K."
S11	Comm link ACK fault	Address of DRCSR of system half's DR-11C	N/A	See System Troubleshooting Flow Chart Entry Point "K."
S12	Comm link queue exceeded	Address of DRCSR of system half's DR-11C	N/A	See System Troubleshooting Flow Chart Entry Point "K."
S15	Mag tape error	Address of TMCSR	Contents of TMCSR	See OEM mag tape manuals.
S16	Mag tape no response	Address of TMCSR	Contents of TMCSR	See OEM mag tape manuals.
S20	System major alarm	N/A	N/A	See Major Alarm Panel Troubleshooting Chart.
S25	Power failure recovery	N/A	N/A	The system has just recovered from a power fail condition.
S99	Error message overflow	N/A	N/A	The system has received more than eight error message requests and the computer cannot print out the error messages in the required time.

NOTES

1. Legend

DSRD	= Data Set Ready Drop
TCU	= Transmitter Control Unit
ASI	= Automatic Station Identification
STR	= Status Register
DCS	= Disc Control Status
RCSR	= Receiver Control Status Register
DRCSR	= DR-11C Control Status Register
TMCSR	= TM-11 Control Status Register
N/A	= Not Applicable
XX	= Appropriate line/paging area/unit — number
LIS	= Line Interface Set (data set plus associated input register unit)

2. Register Address Values

Register	Address (Octal)
Input register of first LIS within input unit	170mn0
Input register of second LIS within input unit	170 mn2
Input register of third LIS within input unit	170mn4
Input register of fourth LIS within input unit	170mn6
Input register of fifth LIS within input unit	170m (n + 1) 0
Input register of sixth LIS within input unit	170m (n + 1) 2
Input register of seventh LIS within input unit	170m (n + 1) 4
Input register of eighth LIS within input unit	170m (n + 1) 6

NOTE
The above pertains to messages I10 thru I14.

where m, n given as follows:

Input Unit	m	n
first (DS 1-8)	0	0
second (DS 9-16)	0	2
third (DS 17-24)	0	4
fourth (DS 25-32)	0	6
fifth (DS 33-40)	1	0
sixth (DS 41-48)	1	2
•	•	•
•	•	•
etc.	etc.	etc.

DCS register of disc-controller	177460
RCSR of first (DC-11) remote teletypewriter interface	174000
RCSR of second (DC-11) remote teletypewriter interface	174010
RCSR of third (DC-11) remote teletypewriter interface	174020
RCSR of fourth (DC-11) remote teletypewriter interface	174030
RCSR of fifth (DC-11) remote teletypewriter interface	174040
RCSR of sixth (DC-11) remote teletypewriter interface	174050
RCSR of seventh (DC-11) remote teletypewriter interface	174060
RCSR of eight (DC-11) remote teletypewriter interface	174070
DRCSR of Comm. Link's DR11-C	177520
DRINBUF of Comm. Link's DR11-C	177524

but pages were transmitted. Minor alarm lamp on alarm panel will light and TCU of failed transmitter will light NO-ON lamp. To latch TCU alarm lamps, see notes on Figures 2-21, 22, 23 in Theory/Service Manual.

02: All transmitters associated with addressed TCU's have failed to turn on properly. No paging occurred. Major alarm lamp on alarm panel will light and TCU's of failed transmitters will light NO-ON.

03: Output unit xx failed to return a page-complete interrupt.

04: Voice ASI message did not give indication of completion to computer.

S1: The disc system's memory unit has experienced one of the following recoverable type errors:

- disc-recoverable error
- parity error on read
- a missed transfer
- a software-detected error where the disc controller doesn't respond within 100 msec.

No data or pages are lost, but frequent occurrence of this alarm indicates possible disc trouble.

Table 7-8. Main Alarm Panel Indicators

Lamp	Description and Function	Reference Number
a. Major Alarms		
Fuse Alarm	+5 and/or +12 V fuse has failed on alarm panel only.	Figure V-26b*
+5 V	Indicates loss of any one of five +5 V system power supplies.	Figure V-26b* Figure 3-2
CPU	Processor has halted.	Troubleshooting Flowchart Entry Point B
TGF	Transmitter Group Fail (when designated as a major alarm).	TCU Troubleshooting Chart
SYN	Tone Synthesizer Fail	Troubleshooting Flowchart Entry Point E Figure V-14b *
—48 V	—48 V to the system has failed. **NOTE** If system is supplied by the station battery the problem is either with the connecting line or the station battery. If not supplied by the station battery, see the reference entry for this lamp.	Figure V-46*
—130 V	See Above	
+12 V	Indicates failure of any of the +12 V supplies.	Figure 3-2 Figure V-26b*
Major Alarm	Signifies failure of the total paging ability of this terminal half.	See System Troubleshooting Flow Chart Figure V-26b*
Disabled	Indicates that the Major Alarm/Reset switch is in the reset or disabled position (it defeats the audible dry closure major system alarm.)	Figure V-26b*
b. Minor Alarm		
LOS	Indicates that an input line is out of service.	Figure III-24*
ANS	Go-ahead Audio Failure	Figure V-31b* Figure V-38b*
RNG	Ring-Back Audio Failure	Figure V-31b* Figure V-41*
VLD	Valid Message Recorder Failure or Valid Tone Failure	Figure V-31b* Figure V-38b*
INV	Invalid Audio Recorder or Tone	See OEM Manual for Code-A-Phone ©
TCU	Indicates failure of at least one RF transmitter.	See TCU Troubleshooting Chart Figure V-20* through V-23*
ASI	Indicates failure of the ASI recorder.	See OEM Manual for Code-A-Phone
FSE	Indicates +12, +5, —48 V fuses in Data Sets or TCU's have failed.	Check all fuses associated with Data Sets and TCU's
TGF	Indicates that a group of TCU's has failed.	See TCU Troubleshooting Chart
Minor Alarm	A combination of any of the above.	Check preceding alarm lights. Figure V-26b*
Disabled (Minor)	Indicates that the minor alarm switch is in the disabled position, inhibiting the audible alarm closure.	Figure V-26b*

* See Theory/Service Manual 68P81007C95.

Table 7-9. TCU Troubleshooting Chart

HALT	Halt the CPU with the Halt switch in the Halt position. Monitor the B INIT L line with an oscilloscope. This line should be high. Actuate the Start switch. The B INIT L line should go low, then return high when the start switch is released.
MONITOR	Monitor the B ADD1, B ADD2, B ADD4, and B ADD8 lines with an oscilloscope; all should be in the high state. If any of these lines are are low, remove the TCU's one at a time until the condition reverses. If all TCU's are removed and the B ADD1, 2, 4, and 8 lines are still low, the output unit is defective. • If DFDD, replace the TCU Interface Board in the Output Unit. • If Binary, replace the Binary Output Unit Board. • If still low, check the MTB/ATB and TCU Rack cabling. • If still low, replace the Output Unit Cable.
TEST	For DFDD, perform the test listed in Table 4-4. For Binary, perform the test listed in Table 4-5.

the STD100•MNT tape for Version 4.6, or STD100•SWP for Version 5 and entering MN at local terminal. The other half may then be returned to service by clearing its disc and performing a program swap procedure from the half restored first.

7.5.1 Single Halted Terminal Half

A single terminal half will generally be halted intentionally by an operator-initiated activation of the HALT switch on the computer control console panel of that terminal half. However, the system itself may initiate the halt automatically (e.g. upon occurrence of a system major alarm condition or upon occurrence of a CPU/peripheral fault condition). Figure 7-10 summarizes the restart procedure for either of the above cases.

This procedure simply transfers program information from the operating terminal half into the halted terminal half and automatically restarts the program in the halted half. The placing of the local terminal teletypewriter of the non-halted side into its "system mode" is required to insure that the "swap command" can be given (see FDS-ID).

7.5.2 Both Terminal Halves Halted

The halting of *both* terminal halves should *never* be implemented by an operator once the terminal is installed and working. Occurrence of this type of halt condition will, thus, indicate a system-initiated halt.

In the case of a fully halted terminal, attempt to resume operation by means of the procedure diagrammed in Figure 7-11. This procedure attempts to first bring up and verify proper operation of one side of the terminal, and follows this with a "swap" of core memory information to the opposite terminal half and automatic restart of this opposite side.

NOTE

The term "prepare for swap" indicated in the diagram includes being sure that the local teletypewriter involved is placed in its "system mode" via the ID function before proceeding.

If the above procedure leads to the conclusion that software of BOTH sides is damaged, for Version 4.6 of METRO 100 Software follow initialization procedure described in paragraph II-2 Operating Manual. For Version 5, lead backup via STD100•SWP, see PDS-SWP Operating Manual.

NOTE

In Figure 7-11, assignment of "side" label is arbitrary--either terminal half may be designated as side A with the opposite half then becoming side B.

IMPORTANT

If persistent system-initiated halts occur in a particular terminal half, the following procedure will facilitate fault localizing.

7.5.2.1 Note what the system is doing when the shutdown occurs (system paging, idling, etc.)

7.5.2.2 If a system fatal error message is printed out by the terminal half's local teletypewriter, save this printout.

7.5.2.3 If no fatal error message is printed out, perform the following steps:

Step 1. Load and examine address 177700_8 to 177707_8 (corresponding to the terminal half CPU program registers), 177710_8, 177712_8 (which correspond to the internal CPU registers), and write down the value existing in each of these registers.

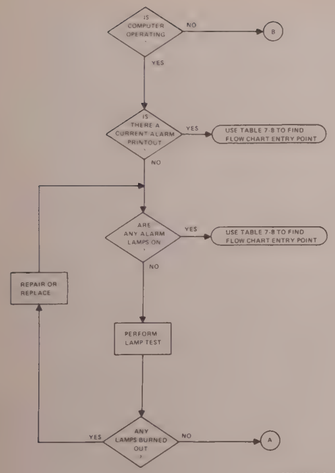
Step 2. Load and examine address 177776_8 (status word location) and write down the value existing at this memory location.

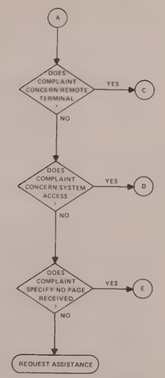
7.5.2.4 If problem cannot be localized, perform the System Test Diagnostics, described in paragraph 7.6 of this section.

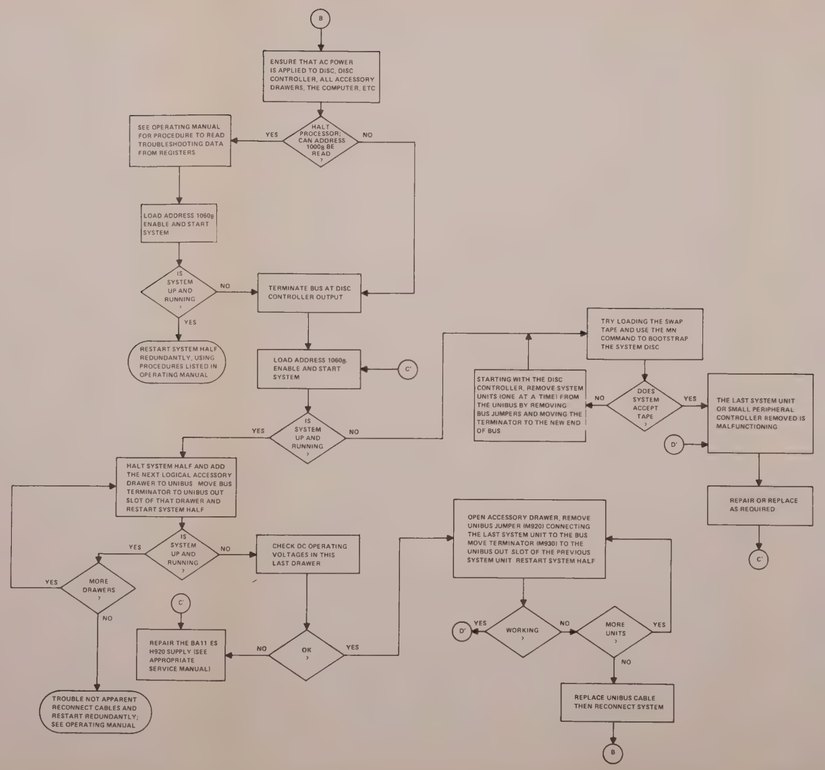
7.6 METRO 100 SYSTEM TEST DIAGNOSTICS

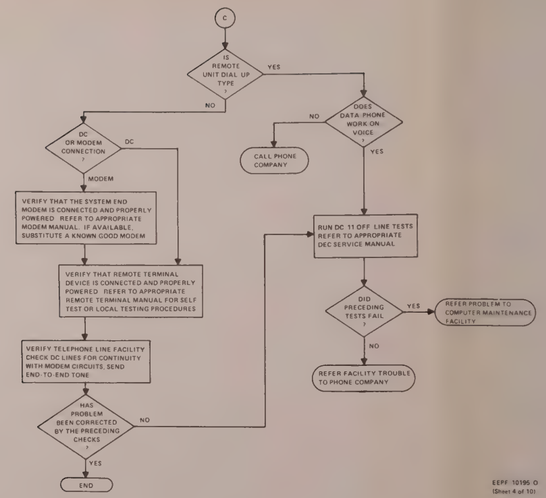
7.6.1 Introduction

The Metro 100 System Test is a run time exerciser (RTE) built from the DEC/X11 Diagnostic Package. The exerciser tests all DEC devices and interfaces available on the Metro 100 Paging Terminal (see Table 7-10). The RTE is a flexible system that runs under user control. This allows user selection of all, one, or specific groups of devices for testing.






B
ENSURE THAT AC POWER IS APPLIED TO DISC, DISC CONTROLLER, ALL ACCESSORY DRAWERS, THE COMPUTER, ETC
HALT PROCESSOR; CAN ADDRESS 1000g BE READ ?
YES
SEE OPERATING MANUAL FOR PROCEDURE TO READ TROUBLESHOOTING DATA FROM REGISTERS
NO
LOAD ADDRESS 1060g ENABLE AND START SYSTEM
IS SYSTEM UP AND RUNNING ?
NO
TERMINATE BUS AT DISC CONTROLLER OUTPUT
YES
RESTART SYSTEM HALF REDUNDANTLY, USING PROCEDURES LISTED IN OPERATING MANUAL
LOAD ADDRESS 1060g ENABLE AND START SYSTEM
C'
IS SYSTEM UP AND RUNNING ?
YES
NO
HALT SYSTEM HALF AND ADD THE NEXT LOGICAL ACCESSORY DRAWER TO UNIBUS. MOVE BUS TERMINATOR TO UNIBUS OUT SLOT OF THAT DRAWER AND RESTART SYSTEM HALF
IS SYSTEM UP AND RUNNING ?
YES
NO
CHECK DC OPERATING VOLTAGES IN THIS LAST DRAWER
MORE DRAWERS ?
YES
NO
C
REPAIR THE BA11 ES H920 SUPPLY (SEE APPROPRIATE SERVICE MANUAL)
OK ?
NO
YES
TROUBLE NOT APPARENT. RECONNECT CABLES AND RESTART REDUNDANTLY. SEE OPERATING MANUAL
TRY LOADING THE SWAP TAPE AND USE THE MN COMMAND TO BOOTSTRAP THE SYSTEM DISC
STARTING WITH THE DISC CONTROLLER, REMOVE SYSTEM UNITS (ONE AT A TIME) FROM THE UNIBUS BY REMOVING BUS JUMPERS AND MOVING THE TERMINATOR TO THE NEW END OF BUS
DOES SYSTEM ACCEPT TAPE ?
NO
YES
D'
THE LAST SYSTEM UNIT OR SMALL PERIPHERAL CONTROLLER REMOVED IS MALFUNCTIONING
REPAIR OR REPLACE AS REQUIRED
C'
OPEN ACCESSORY DRAWER, REMOVE UNIBUS JUMPER (H920) CONNECTING THE LAST SYSTEM UNIT TO THE BUS. MOVE TERMINATOR (H930) TO THE UNIBUS OUT SLOT OF THE PREVIOUS SYSTEM UNIT. RESTART SYSTEM HALF
D'
WORKING ?
YES
NO
MORE UNITS ?
YES
NO
REPLACE UNIBUS CABLE THEN RECONNECT SYSTEM
B
EEPF 10195 O
(Sheet 3 of 10)


C
IS REMOTE UNIT DIAL UP TYPE ?
YES
NO
DC OR MODEM CONNECTION ?
DC
MODEM
VERIFY THAT THE SYSTEM END MODEM IS CONNECTED AND PROPERLY POWERED. REFER TO APPROPRIATE MODEM MANUAL. IF AVAILABLE, SUBSTITUTE A KNOWN GOOD MODEM
VERIFY THAT REMOTE TERMINAL DEVICE IS CONNECTED AND PROPERLY POWERED. REFER TO APPROPRIATE REMOTE TERMINAL MANUAL FOR SELF TEST OR LOCAL TESTING PROCEDURES
VERIFY TELEPHONE LINE FACILITY. CHECK DC LINES FOR CONTINUITY WITH MODEM CIRCUITS. SEND END-TO-END TONE
HAS PROBLEM BEEN CORRECTED BY THE PRECEDING CHECKS ?
NO
YES
END
DOES DATA PHONE WORK ON VOICE ?
NO
CALL PHONE COMPANY
YES
RUN DC 11 OFF LINE TESTS. REFER TO APPROPRIATE DEC SERVICE MANUAL
DID PRECEDING TESTS FAIL ?
YES
REFER PROBLEM TO COMPUTER MAINTENANCE FACILITY
NO
REFER FACILITY TROUBLE TO PHONE COMPANY.
EEPF 10195 O
(Sheet 4 of 10)

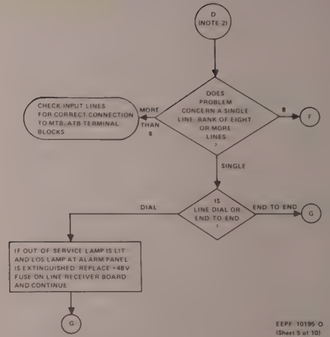
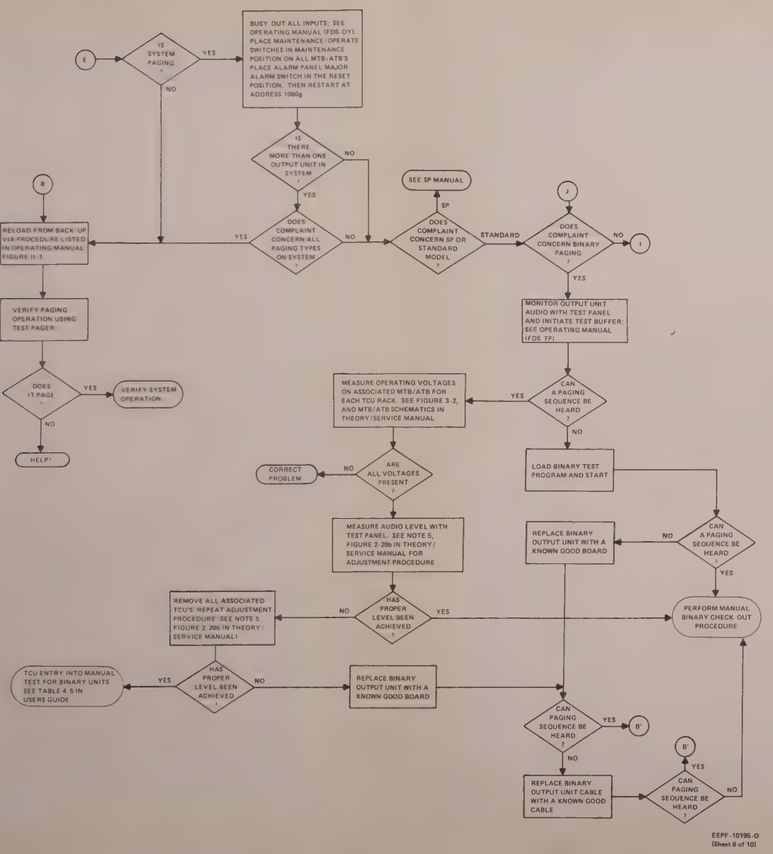

D
(NOTE 2)
CHECK INPUT LINES FOR CORRECT CONNECTION TO MTB, ATB TERMINAL BLOCKS
DOES PROBLEM CONCERN A SINGLE LINE, BANK OF EIGHT OR MORE LINES ?
MORE THAN 8
8
F
SINGLE
IS LINE DIAL OR END TO END ?
DIAL
END TO END
G
IF OUT OF SERVICE LAMP IS LIT AND LOS LAMP AT ALARM PANEL IS EXTINGUISHED, REPLACE +48V FUSE ON LINE RECEIVER BOARD AND CONTINUE
G
EEPF 10195 O
(Sheet 5 of 10)

Figure 7-8. System Troubleshooting Flow Chart (Sheet 1 of 3)


E
IS SYSTEM PAGING ?
YES
NO
BUSY OUT ALL INPUTS; SEE OPERATING MANUAL (FOS-DY); PLACE MAINTENANCE/OPERATE SWITCHES IN MAINTENANCE POSITION ON ALL MTB/ATB'S PLACE ALARM PANEL MAJOR ALARM SWITCH IN THE RESET POSITION. THEN RESTART AT ADDRESS 1060g
IS THERE MORE THAN ONE OUTPUT UNIT IN SYSTEM ?
YES
NO
B
RELOAD FROM BACK-UP VIA PROCEDURE LISTED IN OPERATING MANUAL FIGURE II-3
DOES COMPLAINT CONCERN ALL PAGING TYPES ON SYSTEM ?
YES
NO
SEE SP MANUAL
DOES COMPLAINT CONCERN SP OR STANDARD MODEL ?
SP
STANDARD
J
DOES COMPLAINT CONCERN BINARY PAGING ?
NO
I
YES
VERIFY PAGING OPERATION USING TEST PAGER
MONITOR OUTPUT UNIT AUDIO WITH TEST PANEL AND INITIATE TEST BUFFER; SEE OPERATING MANUAL (FOS-TP)
DOES IT PAGE ?
YES
VERIFY SYSTEM OPERATION
NO
HELP!
MEASURE OPERATING VOLTAGES ON ASSOCIATED MTB/ATB FOR EACH TCU RACK. SEE FIGURE 3-2, AND MTB/ATB SCHEMATICS IN THEORY/SERVICE MANUAL
CAN A PAGING SEQUENCE BE HEARD ?
YES
NO
CORRECT PROBLEM
NO
ARE ALL VOLTAGES PRESENT ?
LOAD BINARY TEST PROGRAM AND START
MEASURE AUDIO LEVEL WITH TEST PANEL. SEE NOTE 5, FIGURE 2-20b IN THEORY/SERVICE MANUAL FOR ADJUSTMENT PROCEDURE
REPLACE BINARY OUTPUT UNIT WITH A KNOWN GOOD BOARD
CAN A PAGING SEQUENCE BE HEARD ?
NO
YES
REMOVE ALL ASSOCIATED TCU'S REPEAT ADJUSTMENT PROCEDURE (SEE NOTE 5, FIGURE 2-20b IN THEORY/SERVICE MANUAL)
HAS PROPER LEVEL BEEN ACHIEVED ?
NO
YES
PERFORM MANUAL BINARY CHECK OUT PROCEDURE
TCU ENTRY INTO MANUAL TEST FOR BINARY UNITS SEE TABLE 4-5 IN USERS GUIDE
YES
HAS PROPER LEVEL BEEN ACHIEVED ?
NO
REPLACE BINARY OUTPUT UNIT WITH A KNOWN GOOD BOARD
CAN PAGING SEQUENCE BE HEARD ?
YES
B'
NO
REPLACE BINARY OUTPUT UNIT CABLE WITH A KNOWN GOOD CABLE
B'
CAN PAGING SEQUENCE BE HEARD ?
YES
NO

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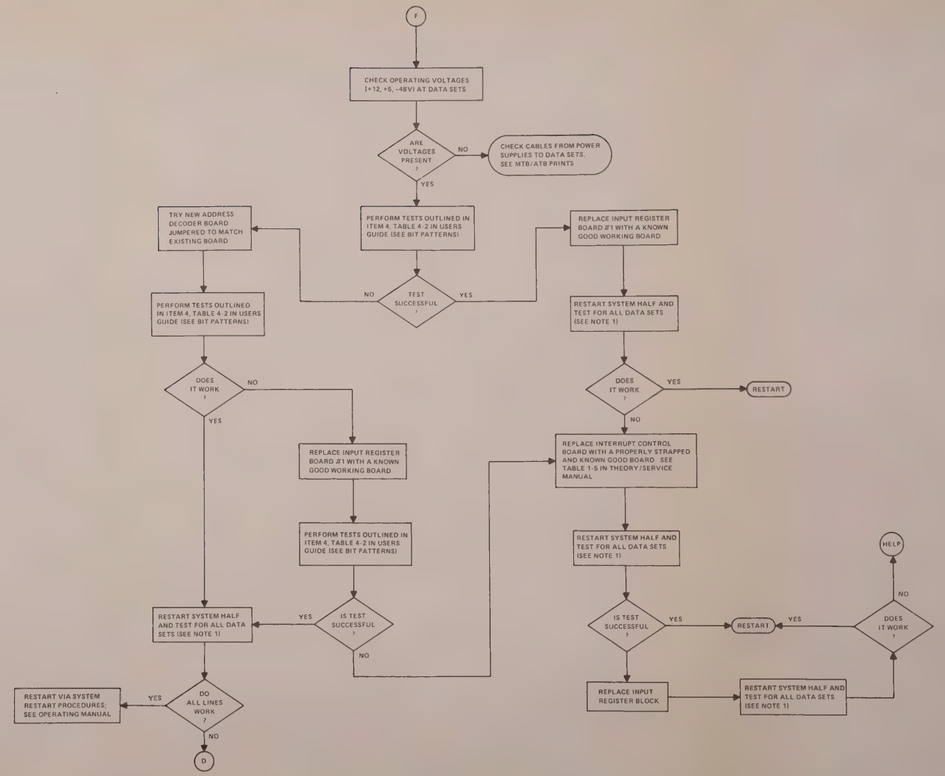
(Sheet 6 of 10)


F
CHECK OPERATING VOLTAGES (+12, +5, -48V) AT DATA SETS
ARE VOLTAGES PRESENT ?
NO
CHECK CABLES FROM POWER SUPPLIES TO DATA SETS; SEE MTB/ATB PRINTS
YES
TRY NEW ADDRESS DECODER BOARD JUMPERED TO MATCH EXISTING BOARD
PERFORM TESTS OUTLINED IN ITEM 4, TABLE 4-2 IN USERS GUIDE (SEE BIT PATTERNS)
REPLACE INPUT REGISTER BOARD #1 WITH A KNOWN GOOD WORKING BOARD
NO
TEST SUCCESSFUL ?
YES
PERFORM TESTS OUTLINED IN ITEM 4, TABLE 4-2 IN USERS GUIDE (SEE BIT PATTERNS)
RESTART SYSTEM HALF AND TEST FOR ALL DATA SETS (SEE NOTE 1)
DOES IT WORK ?
NO
YES
RESTART
REPLACE INTERRUPT CONTROL BOARD WITH A PROPERLY STRAPPED AND KNOWN GOOD BOARD. SEE TABLE 1-5 IN THEORY/SERVICE MANUAL
REPLACE INPUT REGISTER BOARD #1 WITH A KNOWN GOOD WORKING BOARD
PERFORM TESTS OUTLINED IN ITEM 4, TABLE 4-2 IN USERS GUIDE (SEE BIT PATTERNS)
RESTART SYSTEM HALF AND TEST FOR ALL DATA SETS (SEE NOTE 1)
IS TEST SUCCESSFUL ?
YES
RESTART
YES
DOES IT WORK ?
HELP
NO
NO
IS TEST SUCCESSFUL ?
YES
NO
REPLACE INPUT REGISTER BLOCK
RESTART SYSTEM HALF AND TEST FOR ALL DATA SETS (SEE NOTE 1)
RESTART SYSTEM HALF AND TEST FOR ALL DATA SETS (SEE NOTE 1)
YES
DO ALL LINES WORK ?
NO
RESTART VIA SYSTEM RESTART PROCEDURES; SEE OPERATING MANUAL
D

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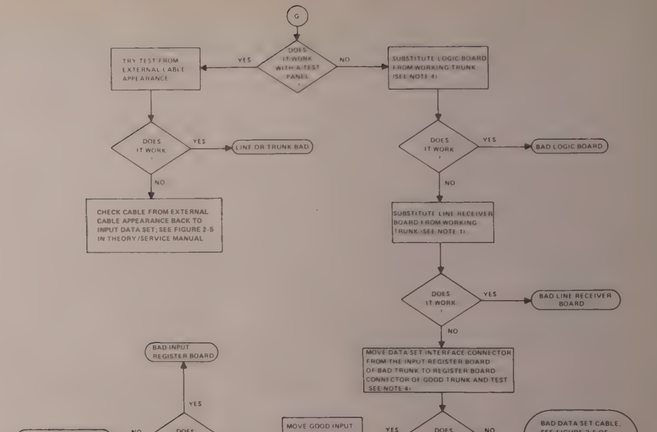
(Sheet 7 of 10)


G
TRY TEST FROM EXTERNAL CABLE APPEARANCE
DOES IT WORK WITH A TEST PANEL ?
YES
NO
SUBSTITUTE LOGIC BOARD FROM WORKING TRUNK (SEE NOTE 4)
DOES IT WORK ?
YES
LINE OR TRUNK BAD
NO
CHECK CABLE FROM EXTERNAL CABLE APPEARANCE BACK TO INPUT DATA SET; SEE FIGURE 2-5 IN THEORY/SERVICE MANUAL
DOES IT WORK ?
YES
BAD LOGIC BOARD
NO
SUBSTITUTE LINE RECEIVER BOARD FROM WORKING TRUNK (SEE NOTE 1)
DOES IT WORK ?
YES
BAD LINE RECEIVER BOARD
NO
MOVE DATA SET INTERFACE CONNECTOR FROM THE INPUT REGISTER BOARD OF BAD TRUNK TO REGISTER BOARD CONNECTOR OF GOOD TRUNK AND TEST (SEE NOTE 4)
DOES IT WORK ?
YES
NO
BAD DATA SET CABLE. SEE FIGURE 2-5 OF THEORY-SERVICE MANUAL (SEE NOTE 3)
MOVE GOOD INPUT REGISTER BOARD TO THE BAD TRUNK SLOT AND TEST
DOES IT WORK ?
YES
NO
BAD INPUT REGISTER BOARD
INPUT REGISTER BLOCK BAD (SEE NOTE 3)

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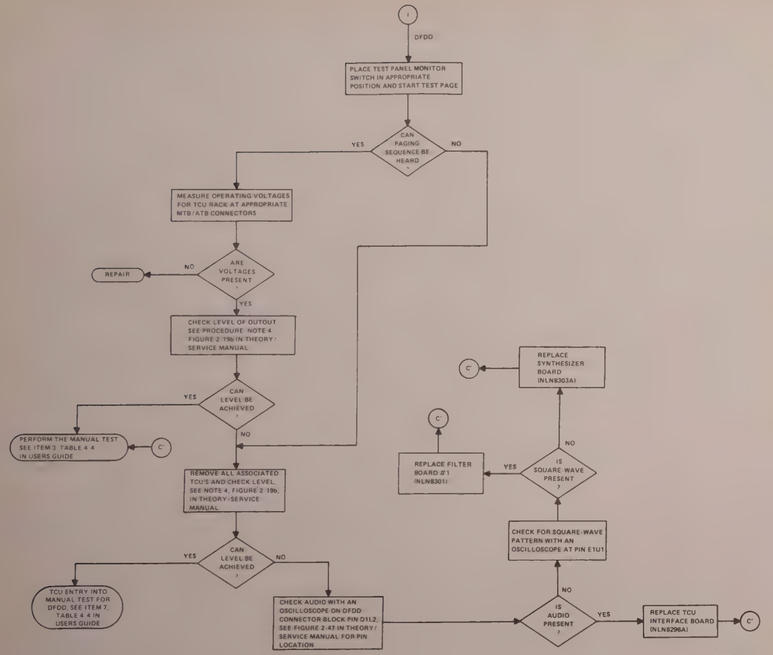
(Sheet 8 of 10)

Figure 7-8. System Troubleshooting Flow Chart (Sheet 2 of 3)


J
DFDD
PLACE TEST PANEL MONITOR SWITCH IN APPROPRIATE POSITION AND START TEST PAGE
CAN PAGING SEQUENCE BE HEARD ?
YES
NO
MEASURE OPERATING VOLTAGES FOR TCU RACK AT APPROPRIATE MTB/ATB CONNECTORS
ARE VOLTAGES PRESENT ?
NO
REPAIR
YES
CHECK LEVEL OF OUTOUT SEE PROCEDURE NOTE 4 FIGURE 2-19b IN THEORY / SERVICE MANUAL
CAN LEVEL BE ACHIEVED ?
YES
PERFORM THE MANUAL TEST SEE ITEM 3 TABLE 4-4 IN USERS GUIDE
C
NO
REMOVE ALL ASSOCIATED TCU'S AND CHECK LEVEL SEE NOTE 4 FIGURE 2-19b IN THEORY / SERVICE MANUAL
CAN LEVEL BE ACHIEVED ?
YES
TCU ENTRY INTO MANUAL TEST FOR DFDD SEE ITEM 7 TABLE 4-4 IN USERS GUIDE
NO
CHECK AUDIO WITH AN OSCILLOSCOPE ON DFDD CONNECTOR BLOCK PIN D11,2 SEE FIGURE 2-47 IN THEORY / SERVICE MANUAL FOR PIN LOCATION
IS AUDIO PRESENT ?
NO
YES
REPLACE TCU INTERFACE BOARD (N/LN9296A)
C
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CHECK FOR SQUARE-WAVE PATTERN WITH AN OSCILLOSCOPE AT PIN E1U1
IS SQUARE-WAVE PRESENT ?
NO
YES
REPLACE FILTER BOARD (F1 (N/LN8301)
C
REPLACE SYNTHESIZER BOARD (N/LN8303A)
C

NOTES

1 REFER TO FIGURE 3-3 FOR DIAL SEQUENCE TEST IN THE USERS GUIDE.
2 LEAVE CARDS AND / OR CABLE CONNECTORS IN TEST POSITION UNTIL THE FOLLOWING TESTS ARE COMPLETE OR UNTIL TOLD OTHERWISE. PLACE ALL MAINTENANCE / OPERATE SWITCHES IN THE MAINTENANCE POSITION. IT IS LOCATED IN SLOT 19 OF THE MTB/ATB FOR THIS HALF ONLY.
3 AFTER PROBLEM HAS BEEN ISOLATED, RETURN ALL CARDS AND/OR CONNECTORS TO THEIR ORIGINAL POSITIONS.
4 REFER TO FIGURE 3-5 FOR END TO END SEQUENCE TEST IN THE USERS GUIDE

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Figure 7-8. System Troubleshooting Flow Chart (Sheet 3 of 3)

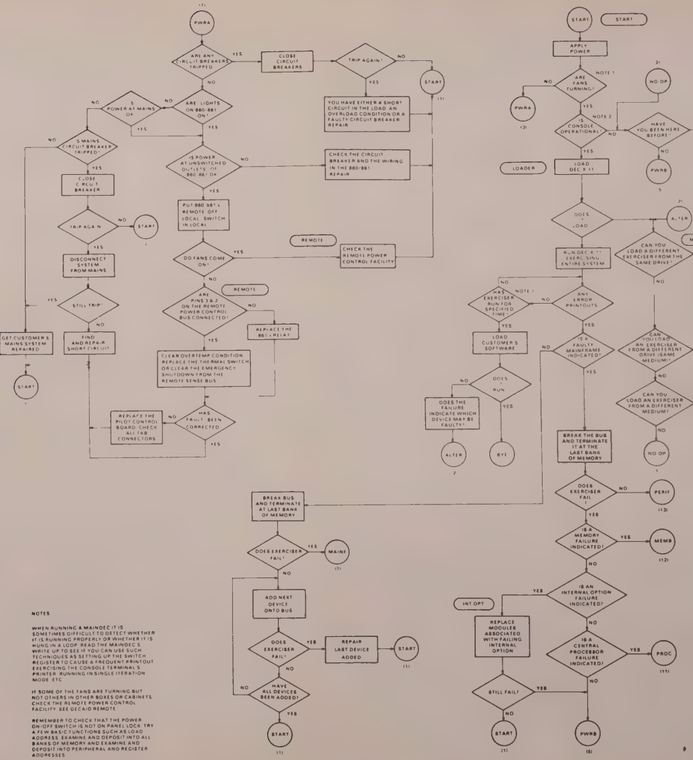

*Figure 7-9. Processor Troubleshooting Flow Chart**

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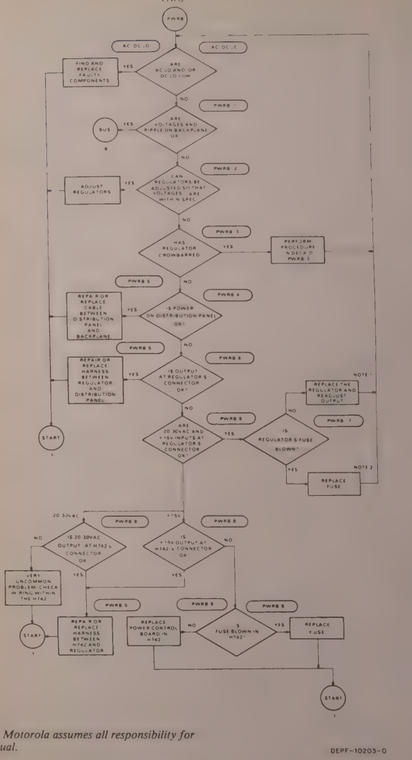
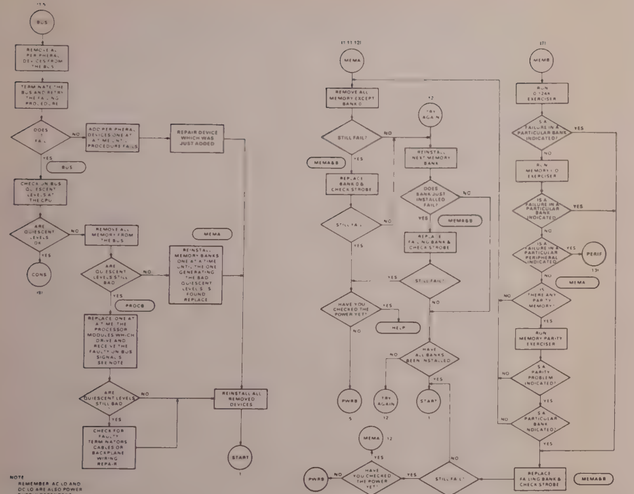
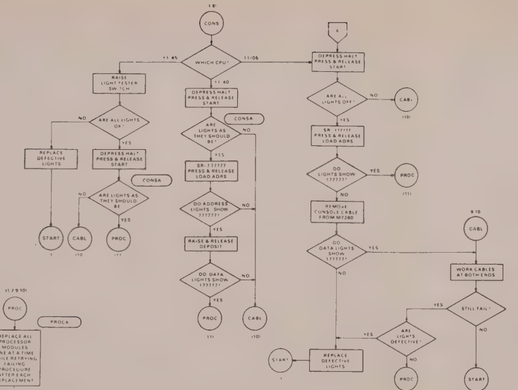



BUS
REMOVE ALL PERIPHERAL DEVICES FROM THE BUS
TERMINATE THE BUS AND REINSTALL ONLY PROCESSOR
DOES IT FAIL
ADD PERIPHERAL DEVICES ONE AT A TIME FOLLOWING PROCEDURE DETAILS
REPAIR DEVICE WHICH WAS JUST ADDED
BUS
CHECK UNIBUS CONTROL LEVELS AT THE CPU
ARE QUIESCENT LEVELS OK
REMOVE ALL MEMORY FROM THE BUS
MEMA
ARE QUIESCENT LEVELS STILL BAD
REINSTALL MEMORY BANKS ONE AT A TIME UNTIL ONE IS FOUND TO BE BAD; QUIESCENT LEVELS IS FOUND REPLACE
PROCB
REPLACE ONE AT A TIME THE FOLLOWING MODULES WHICH DRIVE AND RECEIVE THE FAULTY UNIBUS SIGNALS
ARE QUIESCENT LEVELS STILL BAD
REINSTALL ALL DEVICES REMOVED
CHECK FOR TERMINATORS CABLES OR BACKPLANE WIRING REPAIR
START
CONB
NOTE
REMEMBER AC LO AND DC LO ARE ALSO POWER SUPPLY DEPENDENT



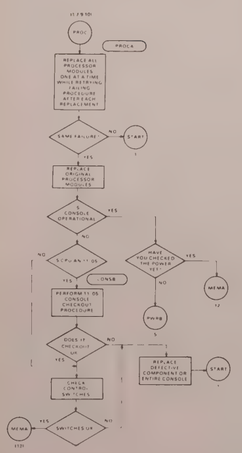


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*Figure 7-9. Processor Troubleshooting Flow Chart (Cont'd.)**

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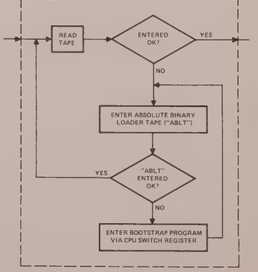
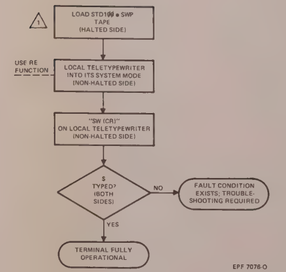
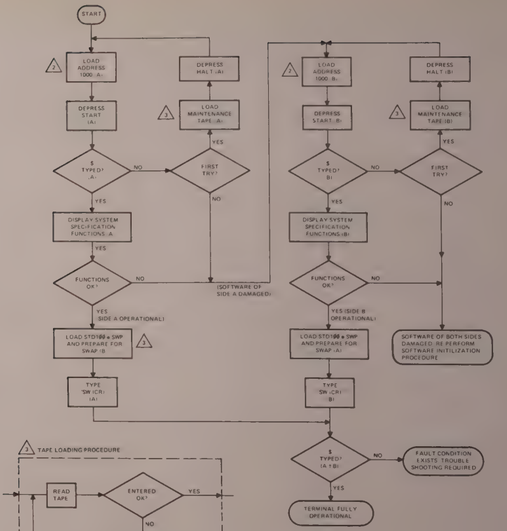




EPF 7076-0

Figure 7-10. Restart Procedure for Single Halted Terminal Half — "Metro-Page" Standard 100 Terminals



NOTES:

1 LEGEND:
(A) - STEP RELATES TO TERMINAL HALF A
(B) - STEP RELATES TO TERMINAL HALF B
(A+B) - STEP RELATES TO BOTH TERMINAL HALVES
2 STEPS IN LOADING ADDRESS 1000
a UNLOCK CPU FRONT PANEL
b DEPRESS HALT KEY
c DEPRESS START KEY ONCE
d SET SWITCH REGISTER KEYS TO 1000 (KEY B UP; REMAINDER OF KEYS DOWN)
e DEPRESS LOAD ADDR KEY ONCE
f RAISE HALT KEY

EPF 7077-0

Figure 7-11. Restart Procedure for Fully Halted Terminal — "Metro-Page" Standard 100 Terminals

This document is a brief summary of the procedures and commands necessary to load and execute the system test. For more detailed information, refer to the following DEC Manuals:

- CXMONA DEC/X11 Monitor Library
- CXQUAA DEC/X11 User Manual
- CXQUBB DEC/X11 Cross-Reference Manual (contains device/option module abstracts)
- CZQXAL XXDP User's Manual

Table 7-10. Equipment Diagnostic List

Device Tested	Module Name	Description
PDP 11/05	ZQKCF0	PDP 11 Family Instruction Exerciser
	ZKARA1	T14 Trap test
	ZKMAF0	MOS/CORE 0-124K Exerciser
	ZKLAE0	KL11/DL11 Teletype tests
	ZKAQG0	Power fail test
	ZKWAG0	KW11-L Line frequency clock
DR11-C	ZDRCH0	DR11C Device register test
DDC Disk	DMSRF0	DMS-RF11 Disk diagnostics
DC11	ZDCAC0	DC11 Off-line tests
PC11	ZPCAE0	PC11 High speed reader and punch test
TM11	ZTMAH2	TM, A, B-11/TS03 or TU10, N, W instruction test
	ZTMBF0	TM11 Data reliability test (9 track)
	ZTMEE0	TMA, B-11 Drive function timer

7.6.2 Configuration

Table 7-11 provides the system configuration information necessary to run the system test.

Table 7-11.
"Metro-Page 100" System Test Configuration

Device	Module Name	Device Address	Vector
B M873-1B	B MHB0	173000_8	NA
DC11	DCAG0	174000_8	300
DR11-C	DRCI0	177520_8	110
KW11-L	KWAG0	177546_8	100
PC11	PCCC0	177550_8	70
RF11/DDC	RFAG0	177460_8	54
TM11	TMAI0	172520_8	224
Straight Line Instruction	CPAG0	NA	NA

NOTE
28k of Memory is required to run the System Test.

7.6.3 Loading Procedure

7.6.3.1 Bootstrap PROM

Step 1. Set the Halt/Enable switch to Halt.

Step 2. Set the switch register toggle arms to the Bootstrap PROM address: 173110_8.

Step 3. Depress the Load Address switch and verify correct entry of 173110_8 into the address register.

Step 4. Set the Halt/Enable switch to Enable.

Step 5. Depress the Start switch. The XXDP monitor should now begin to load.

Step 6. Go to Common Loading Procedure, paragraph 7.6.4.

7.6.3.2 Software Bootstrap (No PROM)

Step 1. Set the Halt/Enable switch to Halt.

Step 2. Set the switch register toggle arms to the starting address of the bootstrap program (010000_8).

Step 3. Depress the Load Address switch and verify correct entry of 010000_8 into the address register.

Step 4. Set the switch register toggle arms to the first instruction (012700_8) and lift the deposit switch (see Table 7-12).

Step 5. Set the switch register toggle arms to the second instruction (172524_8) and lift the deposit switch. Continue until all instructions in Table 7-12 have been entered (see Note).

Step 6. Set the switch register toggle arms to the program beginning address (010000_8) and depress Load Address switch.

Step 7. Set the Halt/Enable switch to Enable and depress the Start switch. The XXDP Monitor will now begin to load.

Step 8. Go to Common Loading Procedure.

Table 7-12. Software Bootstrap

Address	Instruction
010000_8	012700_8
010002_8	172524_8
010004_8	005310_8
010006_8	012740_8
010010_8	060011_8
010012_8	105710_8
010014_8	100376_8
010016_8	005710_8
010020_8	100767_8
010022_8	012710_8
010024_8	060003_8
010026_8	105710_8
010030_8	100376_8
010032_8	005710_8
010034_8	100777_8
010036_8	005007_8

NOTE
The processor automatically advances to the next sequential address (current address plus octal value 2) after each instruction deposit entry.

7.6.4 Common Loading Procedure

Step 1. When the XXDP monitor is loaded, the program will identify itself by printing:

```
DZQUF-G 22-OCT-77 TMDP - XXDP TM11 MONITOR 28K
RESTART ADDR:150134
BOOTED VIA UNIT#:  0
TO ABORT THE FOLLOWING HELP MESSAGE TYPE CTRL C (^C)

TYPE:
F<CR> TO SET CONSOLE FILL COUNT
D<CR> FOR DIRECTORY ON CONSOLE, OR
D/F<CR> FOR SHORT DIRECTORY ON CONSOLE, OR
D/L<CR> FOR DIRECTORY ON LINE PRINTER, OR
D/L/F<CR> FOR SHORT DIRECTORY ON LINE PRINTER,
R COPY<CR> TO RUN COPY PROGRAM,
R FILENAME<CR> TO RUN ANY OTHER PROGRAM.
L FILENAME<CR> TO LOAD A PROGRAM ONLY
S<CR> TO START THE PROGRAM JUST LOADED,
S ADDR<CR> TO START THE PROGRAM AT SPECIFIC ADDRESS
C FILENAME<CR> TO RUN A CHAIN,
C FILENAME/QV<CR> TO RUN A CHAIN IN QUICK VERIFY MODE.
REFER TO XXDP USER MANUAL MD-11-DZQXA FOR ADDITIONAL HELP.
```

Print-Out 7-1. XXDP Program Identification

Step 2. To initiate the Metro 100 system test enter:

.R DECX11 (CR)

Step 3. The system test should now begin to load. When the load is complete the program will identify itself by printing:

```
.R DECX11

DEC/X-11 EXERCISER (MONITOR V00.0) MD-ZZ-CXMON-A
MONITOR:  B
SYSTEM SIZE: 00028 K
WRITE BUFFER ROTATION ON
TO TEST LD MEDIA CLR LOC 40
CMD>
```

Print-Out 7-2. DECX11 Program Identification

NOTE

The system test monitor restart address is 1000.

Step 4. Once the run time exerciser (RTE) has loaded and identified itself as above, the RTE will prompt with CMD>. Before running the exerciser, complete the following setup procedures. First, reset the fill count by entering the command FILL 40 0. The RTE will return with FILL/020000. Deselect all devices by issuing the DES command and procede to select the desired devices by using the SEL command followed by the appropriate module name for the device to be exercised. Table 7-11 gives the list of devices and module names. For the DC11, any units besides the first unit on the system will require modification of the RTE to exercise the correct unit. To modify the RTE for units other than the first, the procedure is as follows:

- Enter MAP command. This should give a printout similar to sample print-out 7-3.
- Enter MOD command with the address following the VA in the MAP printout for the DC11 file.
- The RTE will printout the address followed by a six digit number, which is the contents of the address. One enters a line feed to advance to the next address or a carriage return to close the location and return to the command mode. Advance locations until the contents is either 174000_8 or 000300_8. At 174000_8, type in $1740xx_8$, where xx is given below. If 300_8 is reached first, enter $3xx_8$, where xx is given below. In either case, advance until the other is found and changed. After the last of the two, return to the command mode by closing the location with a carriage return after the entry.

Unit #	xx
2	10_8
3	20_8
4	30_8
5	40_8
6	50_8
7	60_8
8	70_8

The KW11 should be selected all the time, as this has to be selected for the times in the printouts to be valid.

For each device exercise, the corresponding listings should be consulted for device setup. In particular, the DR11C must have the redundancy cables removed and a test cable attached from connector 1 to connector 2 of the same board. The cable should be connected such that pin A of connector 1 goes to pin VV of connector 2. Each DC11 that is exercised must have the modem cable disconnected from the modem and a turnaround connector attached. The turnaround connector can be built from a female 25 pin Cinch connector by soldering the following pins together: 5-8-20; 4-22; 2-3; 11-12.

NOTE

After running the RTE be sure to reconnect the link and modem cables correctly.

The RTE starts execution upon entering the RUN command. If the KW11 is selected, a time message will be printed out every 5 minutes of execution. Unless the pass count messages are selected (see Users manual) for selection procedures) the only other messages will be error messages. These are highlighted in the next section and a more detailed description can be attained from the DEC/X11 Users manual. A summary of the RTE's progress can be obtained by entering SUM at any time.

NOTE

If the RF11 (DDC disk) is selected, the contents of the disk will be destroyed. Make sure a current backup is available before exercising the disk.

7.6.5 Error Messages, XXDP Resident Monitor

The following error messages are produced by the resident monitor when an error condition is encountered in the loading of the Run Time Exerciser (RTE).

INVCMD/SW	Invalid Command and/or Switch, check command just given.
DEVERR	Device Error on input device.
EOM	End of Medium, occurs during input operations when the program attempts to input and the file is at an end. Serious problem. File in storage is probably wiped out.
INVADR	Invalid Address. Must be even within existing Locore and Hicore limits, and must not be within update program.
CKSMER	Checksum Error during "load" command.
POFLO	Program Overflow, it is too large to load within existing core space.
INVNAM	Invalid Name. Invalid character typed for file name.
NEXFIL	Non-Existent File. If in chain mode, the program to be run does not have .BIC extention.

7.6.6 User Commands

The following is a list of the most common user commands for the Metro 100 system test. Table 7-13 contains all user commands for the DEC/X11 Exerciser Monitor B. For more detail, refer to the DEC/X11 User Manual.

7.6.6.1 DES-Deselect

All RTE test modules are active when the exerciser is initially loaded via the XXDP Monitor. The DES command enables test modules to be excluded from the exerciser test sequence.

CMD> DES filename
Deselects the test module named.

CMD> DES

Deselect all test modules. The user would then use the SEL command to select the specific modules to be run.

7.6.6.2 Map

Gives a memory map and current status of the system test (RTE).

```
CMD>MAP
CMD>
RFAGO AT VA: 050440 STAT: 150000
KWAGO AT VA: 056166 STAT: 140000
PCCCO AT VA: 060034 STAT: 140000
TMAIO AT VA: 061132 STAT: 150000
DCAGO AT VA: 065640 STAT: 140000
DLBBO AT VA: 071150 STAT: 140000
DRCIO AT VA: 076374 STAT: 140000
CPAGO AT VA: 054304 STAT: 040020
BMHBO AT VA: 064706 STAT: 040020
CMD>
```

Print-Out 7-3. System Test Status and Memory Map

7.6.6.3 Run

The run command starts execution of the selected RTE test modules.

CMD> RUN

Control C (↑C) will return system to command mode.

7.6.6.4 SEL-Select

The SEL commands provide for the selection of all or specific devices to be included in the exerciser test sequence.

CMD> SEL
Selects all devices for testing.

CMD> SEL filename
Selects specific device for testing.

7.6.6.5 Sum

Gives a summary of system run statistics. SUM gives summary of test system (see Print-out 7-4). SUM filename gives summary of test module named.

- Column Description of Print-out 7-4

A. Test Module Name
B. Beginning memory address for test program.
C. Module status -

STAT ABCDEF

NOTE

B — User specified via test system monitor value
0 — Module Deselected (DES)
4 or 5 — Module Selected (SEL)
6 or 7 — Module Selected and Dropped

The remainder of the status word is predefined for each test module at time of RTE build. See DEC/X11 device/option module abstracts for more detail.

D. Test Pass Counts
E. Hardware Error Count
F. Software Error Count

Table 7-13. User Commands DEC/X11 Monitor B

DES	Deselect
EXAM	Examine Location
FILL	Filler Word
LPOFF	Line Printer Off
LPON	Line Printer On
MAP	RTE Memory Map
MOD	Modify Location
POFF	Parity/ECC Off
PON	Parity/ECC On
RUN	Run Mode
SEL	Select
SUM	Summary
SWR	Switch Register

For more detail, refer to the DEC/X11 Users Manual.

7.6.7 Error Messages

Error reports vary depending upon the device tested, but generally conform to one of the following formats.

```
CMD>RUN
BSY>SUM
BSY>
SUMMARY AT RUNTIME: 000:00:00
RFAGO AT VA: 050440 STAT 110000 PASS #00000 HRDERRS 00000 SFTERRS 00000
KWAGO AT VA: 056166 STAT 100000 PASS #00000 HRDERRS 00000 SFTERRS 00000
PCCCO AT VA: 060034 STAT 100000 PASS #00000 HRDERRS 00000 SFTERRS 00000
TMAIO AT VA: 061132 STAT 154001 PASS #00000 HRDERRS 00000 SFTERRS 00000
DCAGO AT VA: 065640 STAT 100000 PASS #00000 HRDERRS 00000 SFTERRS 00000
DLBBO AT VA: 071150 STAT 100000 PASS #00000 HRDERRS 00000 SFTERRS 00000
DRCIO AT VA: 076374 STAT 100000 PASS #00000 HRDERRS 00000 SFTERRS 00000
CPAGO AT VA: 054304 STAT 000020 PASS #00000 HRDERRS 00000 SFTERRS 00000
BMHBO AT VA: 064706 STAT 000020 PASS #00000 HRDERRS 00000 SFTERRS 00000
SYSTEM ERRORS: 00000      POWER FAILS: 00000
```

A B C D E F

Print-Out 7.4 Test System Summary

7.6.7.1 Format 1

Where:

DCAGO	Failing Module Name
PA	Absolute Address of Error
APC	Relative Address of Error Within Test Module
PASS	Pass Number During Which Error Occurred
HARD ERR	Error Count in Current Run
CSRA	Address of Control/Status Register of Device 0 if Not Applicable
CSRC	Contents of Control/Status Register 0, if Not Applicable
ASTAT	Contents of Status Register, if Applicable
ERRTYP	Error Type Code (see Table 7-14)

7.6.7.2 Format 2

Where:

DRCIO	Failing Module Name
PA	Absolute Address of Error
APC	Relative Address of Error Within Test Module
PASS	Pass Number During Which Error Occurred
S/B	Expected Data (Good Data)
WAS	Obtained Data (Bad Data)
WRADR	Address of Expected Data
RDADR	Address of Bad Data

7.6.7.3 Format 3

Where:

VECTOR	Error Trap Location 4-Bus Error 10-Reserved Instruction
PC+	PC That Was Pushed On the Stack at the Time of Failure
ADDR	Absolute Address of Error
PSW	Processor Status at Time of Failure
SP	Contents of Stack Pointer (R6) Immediately After theTrap
ERCT	Error Count for Current Run
AT DCAG3	Failing Module Name and Relative Address Within Module Where Trap Occurred

```
BSY>
TMAIO PA: 00063300 APC: 002146 PASS #00000 HARD ERR#00001
CSRA: 172520 CSRC: 100000 ASTAT: 000000 ERRTYP: 000000
100000 160302 177000 063536 177377 100000 000017
```

Print-Out 7-5. Error Report, Format 1

```
DCAGO PA: 00056700 APC: 001702 PASS #00000 ERR #00001
CSRA: 174000 S/B: 000003 WAS: 000001 WRADR 00057522 RDADR 00056774
```

Print-Out 7-6. Error Report, Format 2

```
**  SYSTEM ERROR  **

VECTOR    PC+       ADDR      PSW       SP      ERCT
000004   067524  00067524   000011   067352   00001
AT DCAG3 000376
```

Print-Out 7-7. Error Report, Format 3

7.6.8 DEC/X11 Error Type Codes

Table 7-14. Run Time Exerciser (RTE) Error Codes

ERROR	TYPE
0	Not Defined
1	Data Error
2	Data Late
3	Controller Not Ready
4	Block Not Found
5	Block Missed
6	Device Off-Line, Non-Existent Or Not Ready
7	Selection Error
10	Non-Existent Memory
11	Illegal Interrupt Occurred or "Done" Did Not Set
12	Premature End of File Encountered
13	Rewind Error (Rewind Took Too Long)
14	# of Interrupts Incorrect
15	Incorrect Vector Address
16	"Busy" Won't Let Clear In Time
17	Unknown Receiver Error
20	Unknown Transmitter Error
21	Overrun Error
22	Framing Error
23	Device Failed to Interrupt
24	Time-Out-Shift Out Error
25	Bit Stuck In Register or Did Not Change State in Time
26	A/D Conversion Out of Spec.
27	Interrupt Enable Error
30	Unknown Error During Data Transfer
31	A/D RMS or Peak Noise Exceeded Limit
32	NPR Error
33	Device Not in Maintenance Mode
34	Device Will Not Initialize
35	Buffer Fill Error
36	Unable to Execute a Read Function
37	Unable to Execute a Write Function
40	Transfer Read Bit Did Not Set
41	Transfer Data Late Error
42	Active Bit In Register Should Be Set-Not Cleared
43	Cyclic Redundancy Check Error Detected
44	Flag Should Not Be Set
45	Floating Point Mathematical Operation Produced Incorrect Results
46	Clock Overflow Failed To Trigger A/D Conversion
47	Controller Would Not Clear
50	Data Set Line Change
51	Bad Seek
52	Micro Code Not Loaded

8. SYSTEM CONFIGURATION

Each "Metro-Page" 10/100 rack layout is unique and no two are alike. Therefore, the following blank equipment rack outline sheets have been provided and are to be completed upon installation of the equipment. Completion of these figures will help to familiarize the user with the various types of equipment contained in each rack. In addition, the completed figures will provide a permanent record of the rack configuration.

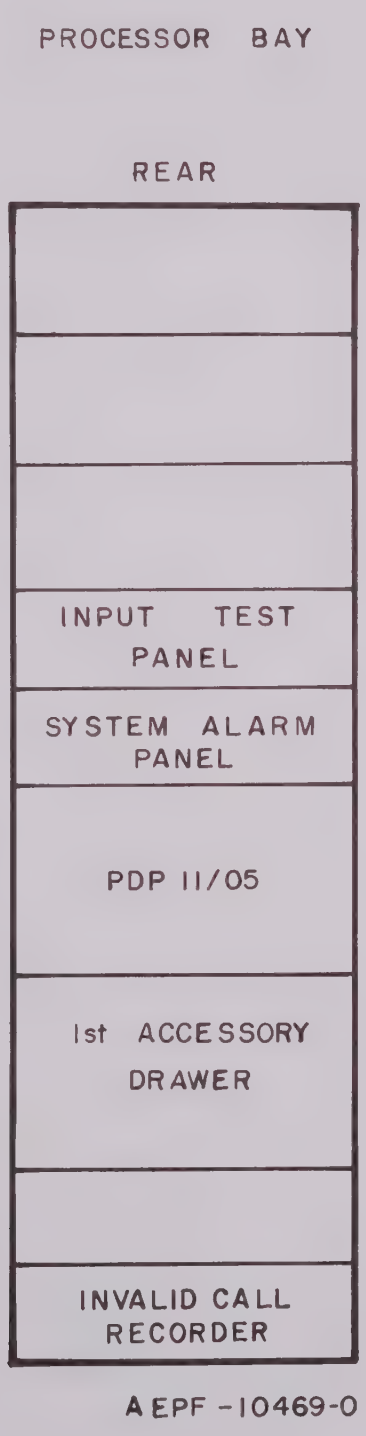


Figure 8-1. Processor Bay Layout, Front View

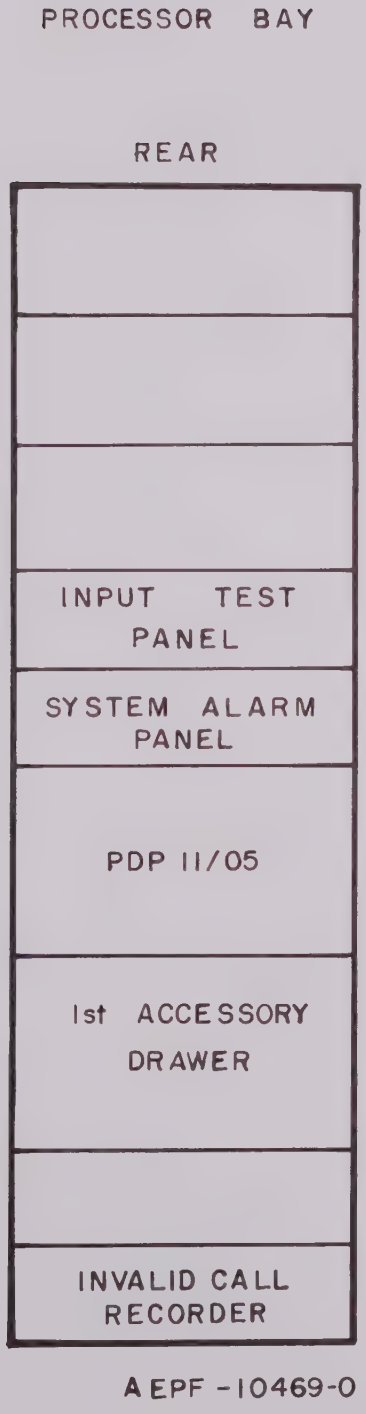


Figure 8-1. Processor Bay Layout, Front View

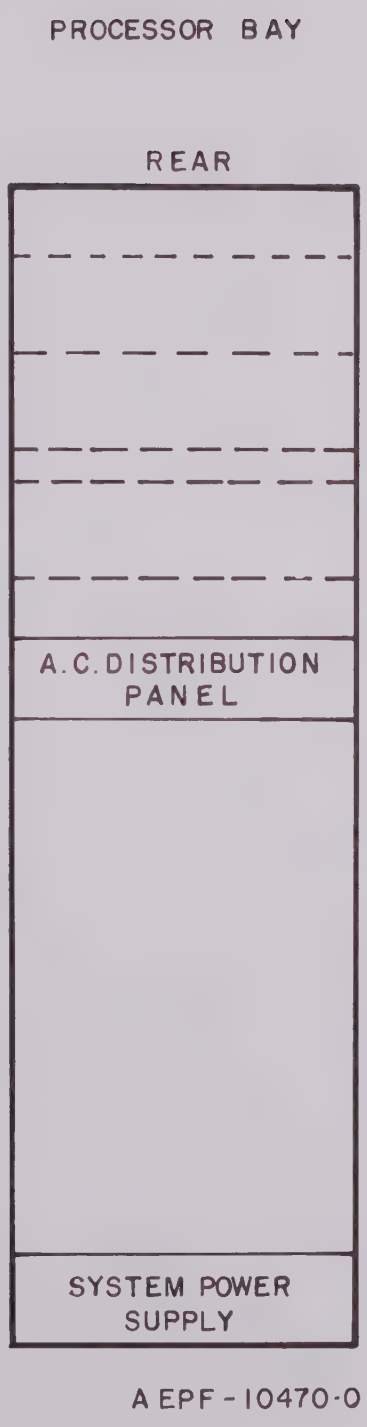


Figure 8-2. Processor Bay Layout, Rear View

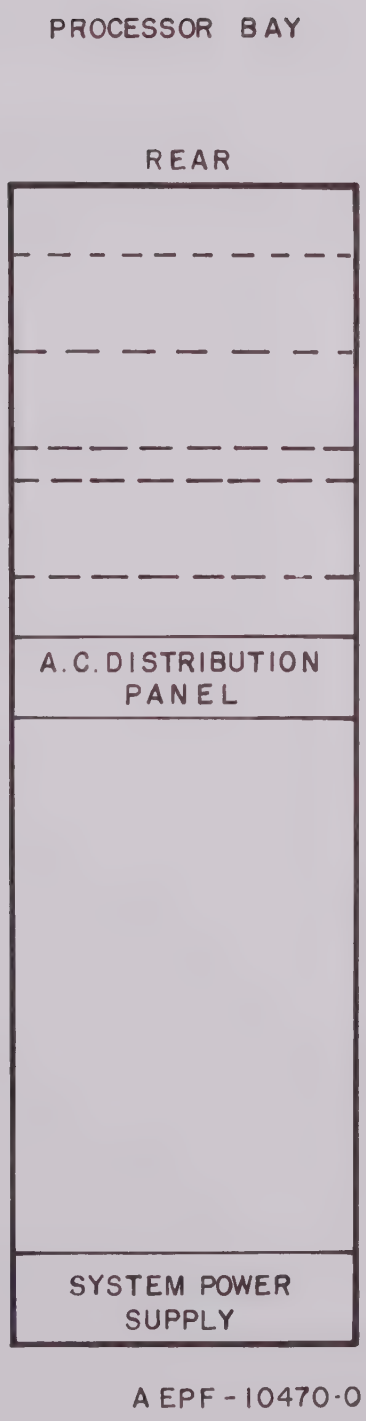


Figure 8-2. Processor Bay Layout, Rear View

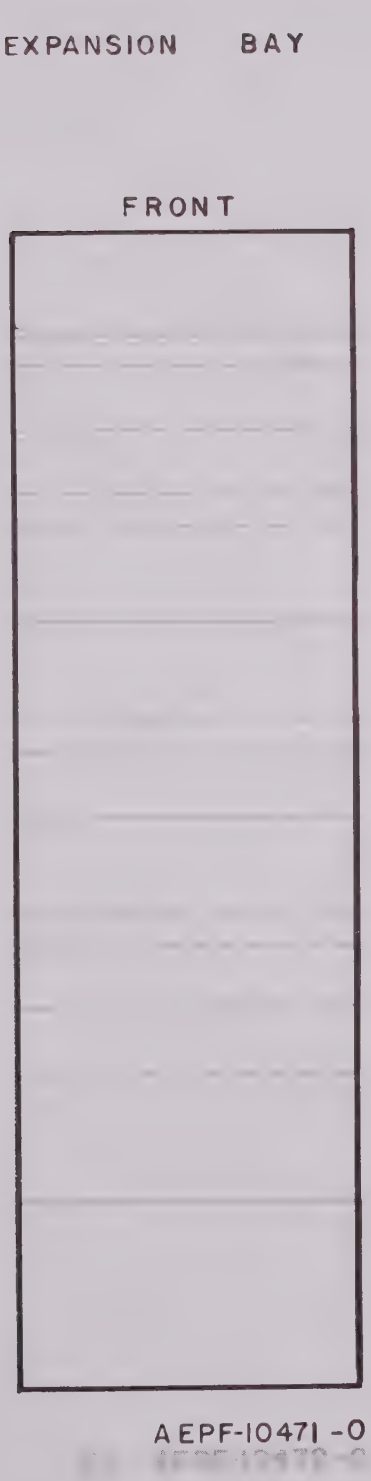


Figure 8-3. Expansion Bay Layout, Front View

Figure 8-3. Expansion Bay Layout, Front View

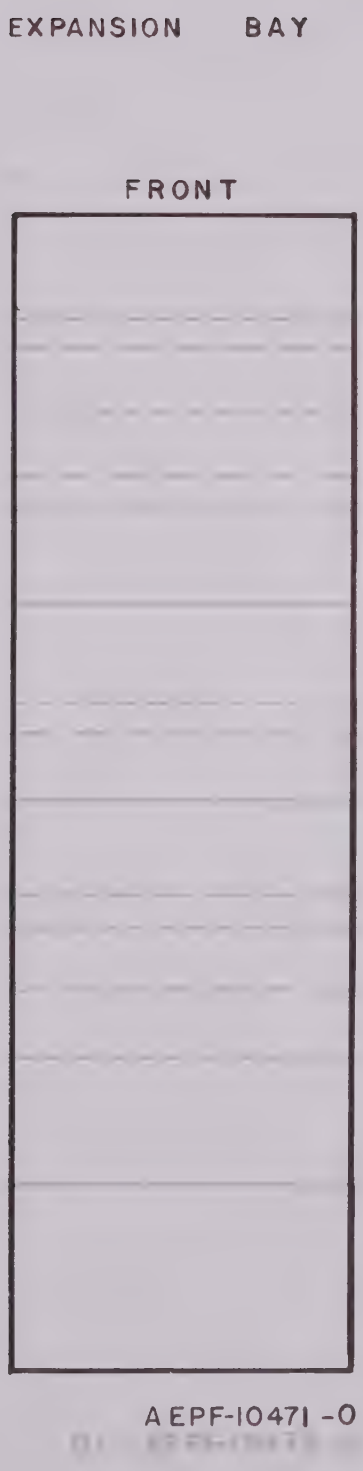


Figure 8-3. Expansion Bay Layout, Front View

Figure 8-3. Expansion Bay Layout, Front View

Figure 8-3. Expansion Bay Layout, Front View

Figure 8-3. Expansion Bay Layout, Front View

Figure 8-3. Expansion Bay Layout, Front View

Figure 8-3. Expansion Bay Layout, Front View

Figure 8-4. Expansion Bay Layout, Rear View

Figure 8-4. Expansion Bay Layout, Rear View

Figure 8-4. Expansion Bay Layout, Rear View

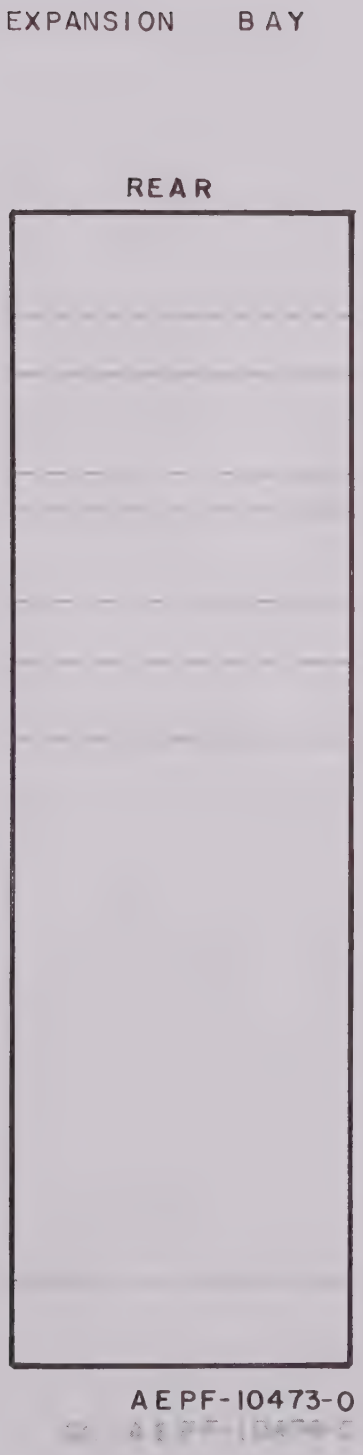


Figure 8-4. Expansion Bay Layout, Rear View

Figure 8-4. Expansion Bay Layout, Rear View

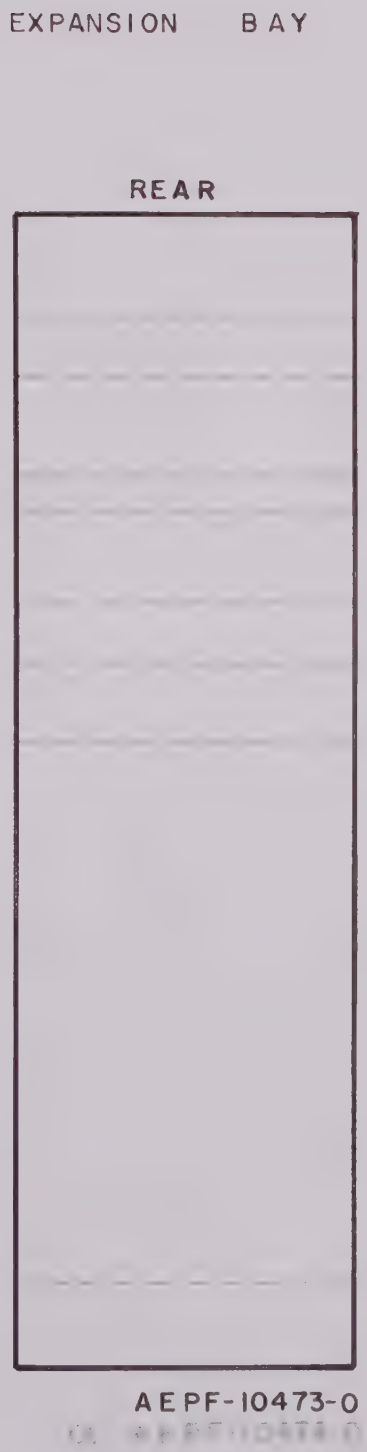


Figure 8-4. Expansion Bay Layout, Rear View

Figure 8-4. Expansion Bay Layout, Rear View

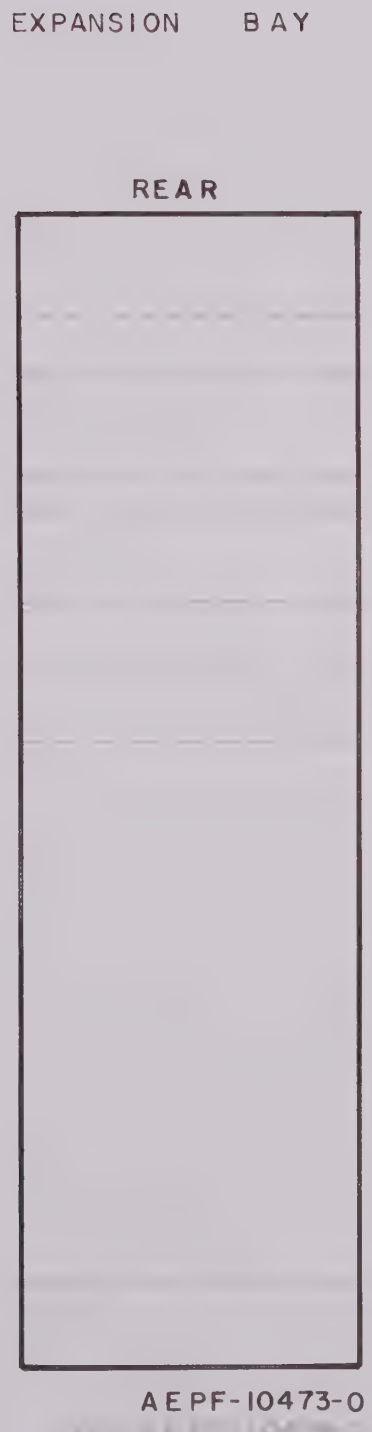
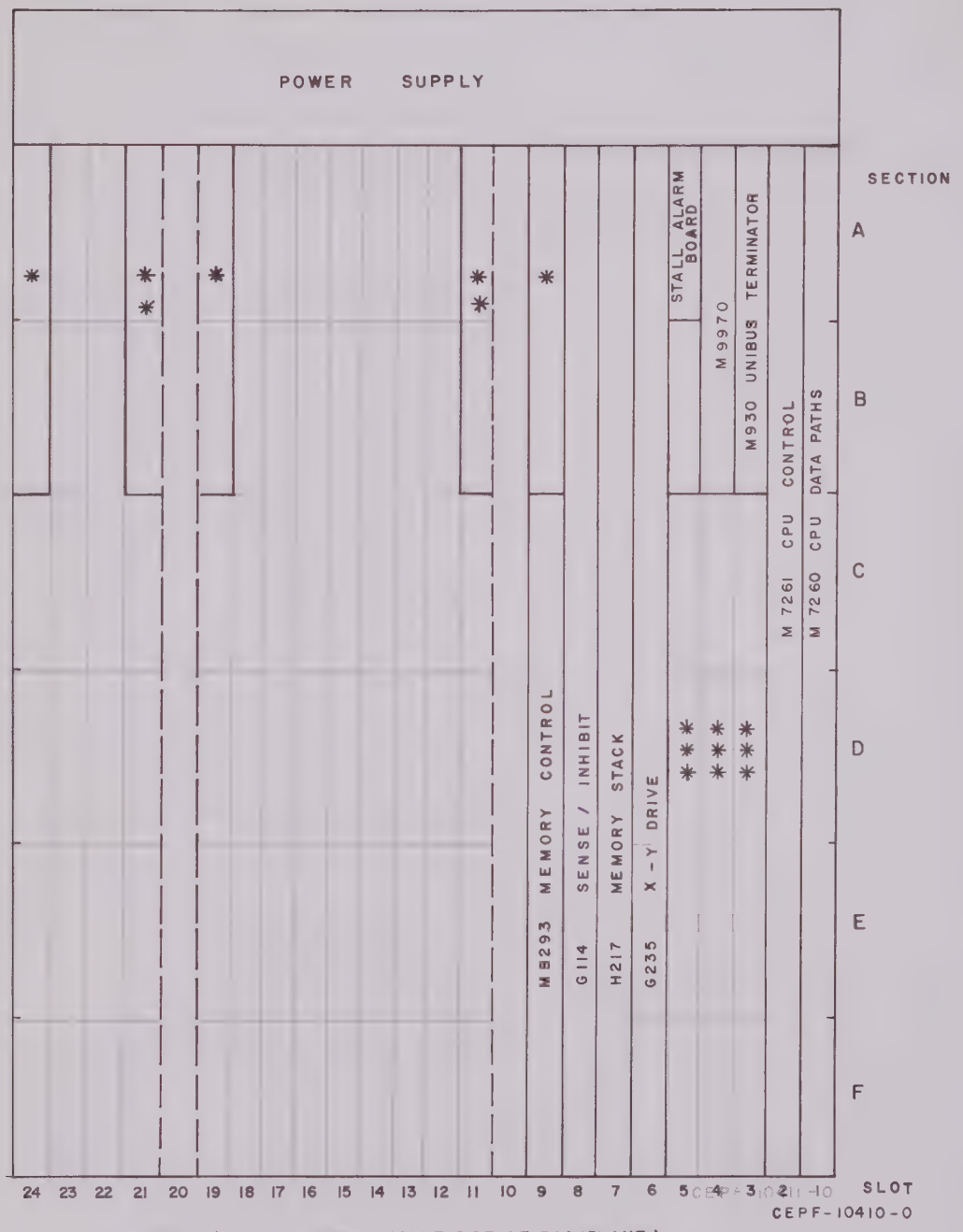


Figure 8-4. Expansion Bay Layout, Rear View

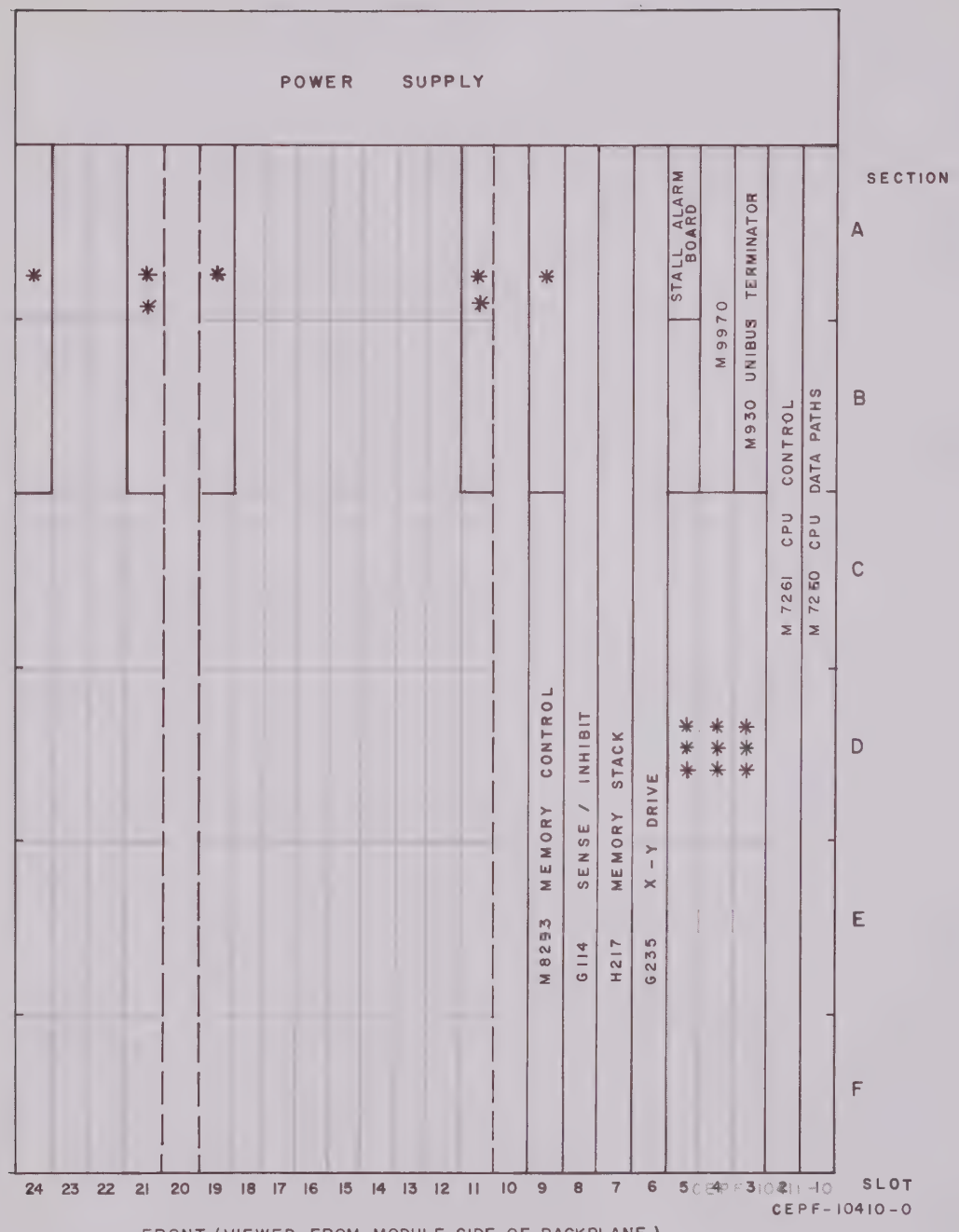


* MAY BE EITHER UNIBUS JUMPER TO NEXT BLOCK, UNIBUS CABLE OUT, OR UNIBUS TERMINATOR.

* * MAY BE EITHER UNIBUS JUMPER FROM PROCEDING BLOCK OR UNIBUS CABLE IN

* * * IF NO INTERFACE IS PRESENT, A G727 GRANT CARD MUST BE INSTALLED IN SECTION D.

Figure 8-5. Computer Bay Layout



* MAY BE EITHER UNIBUS JUMPER TO NEXT BLOCK, UNIBUS CABLE OUT, OR UNIBUS TERMINATOR.

* * MAY BE EITHER UNIBUS JUMPER FROM PROCEDING BLOCK OR UNIBUS CABLE IN

* * * IF NO INTERFACE IS PRESENT, A G727 GRANT CARD MUST BE INSTALLED IN SECTION D.

Figure 8-5. Computer Bay Layout

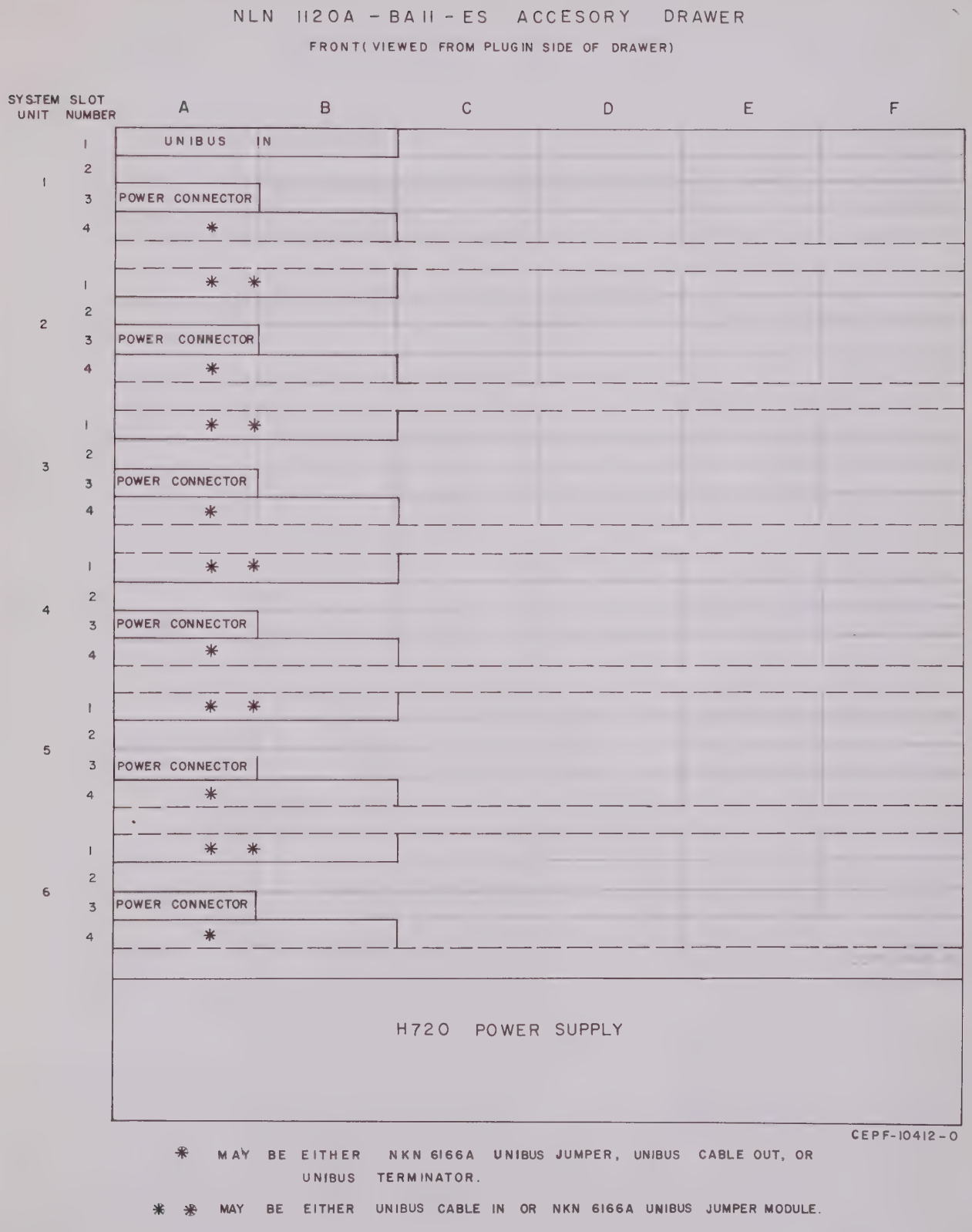


Figure 8-6. Accessory Drawer Layout

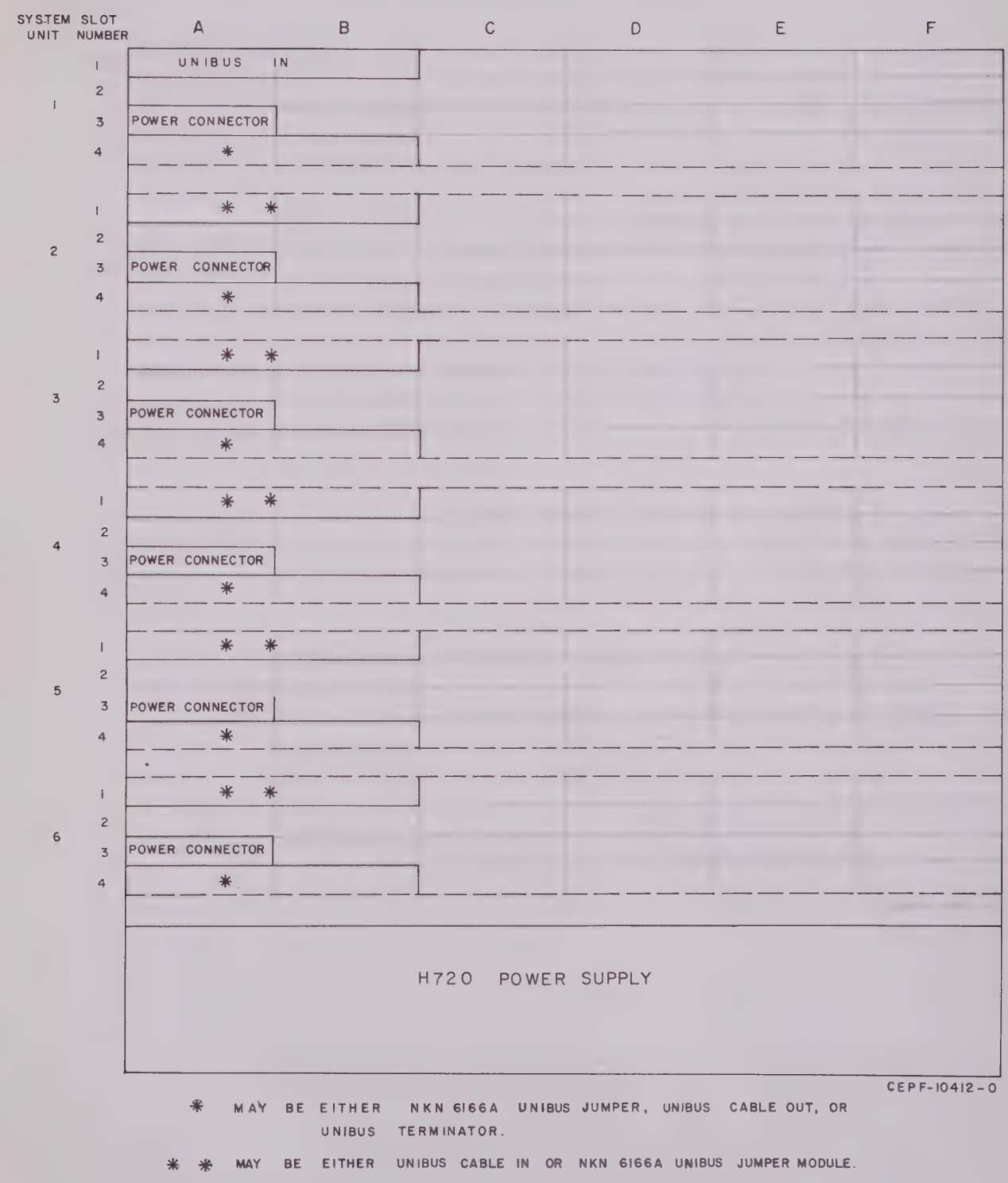


Figure 8-6. Accessory Drawer Layout

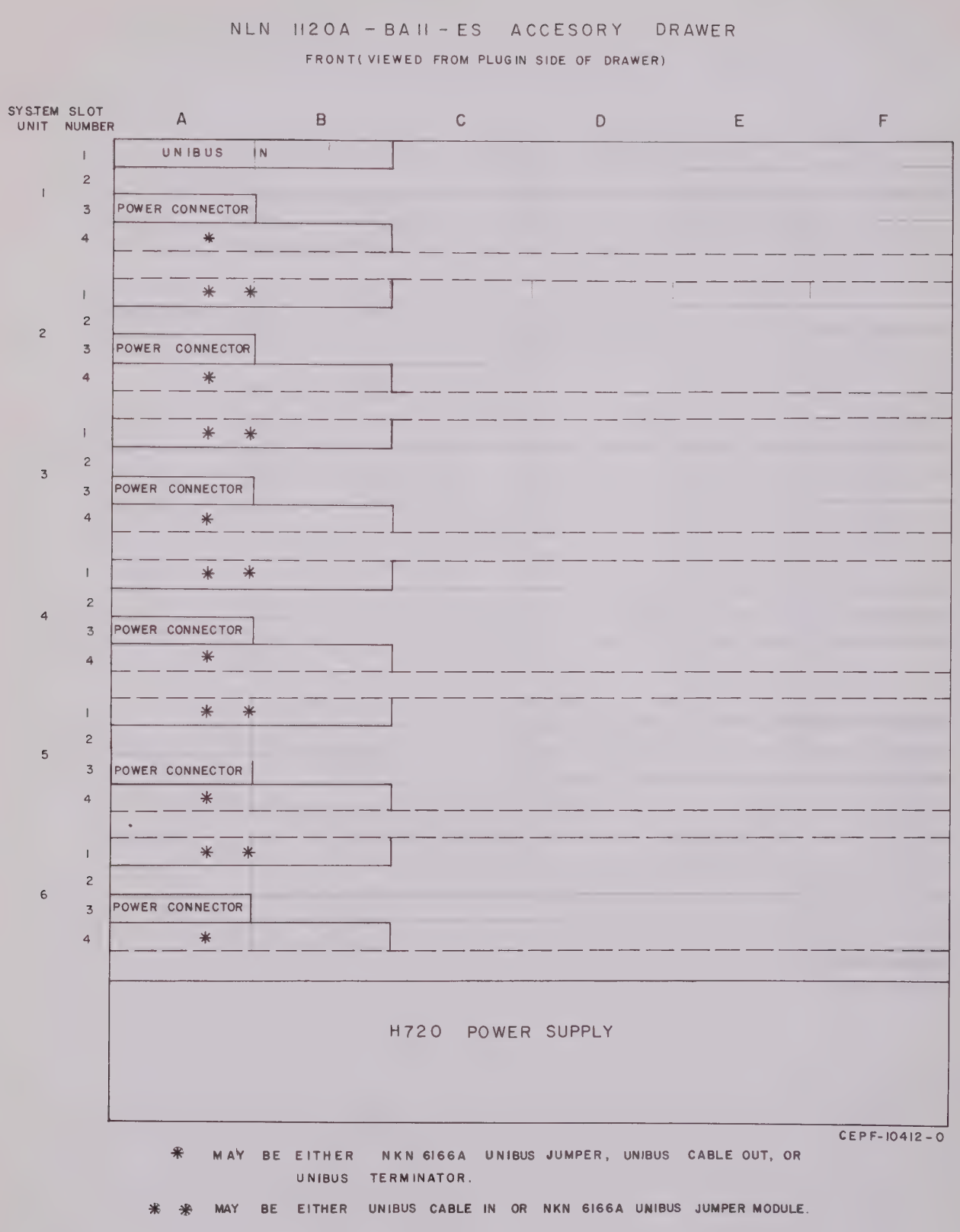


Figure 8-6. Accessory Drawer Layout

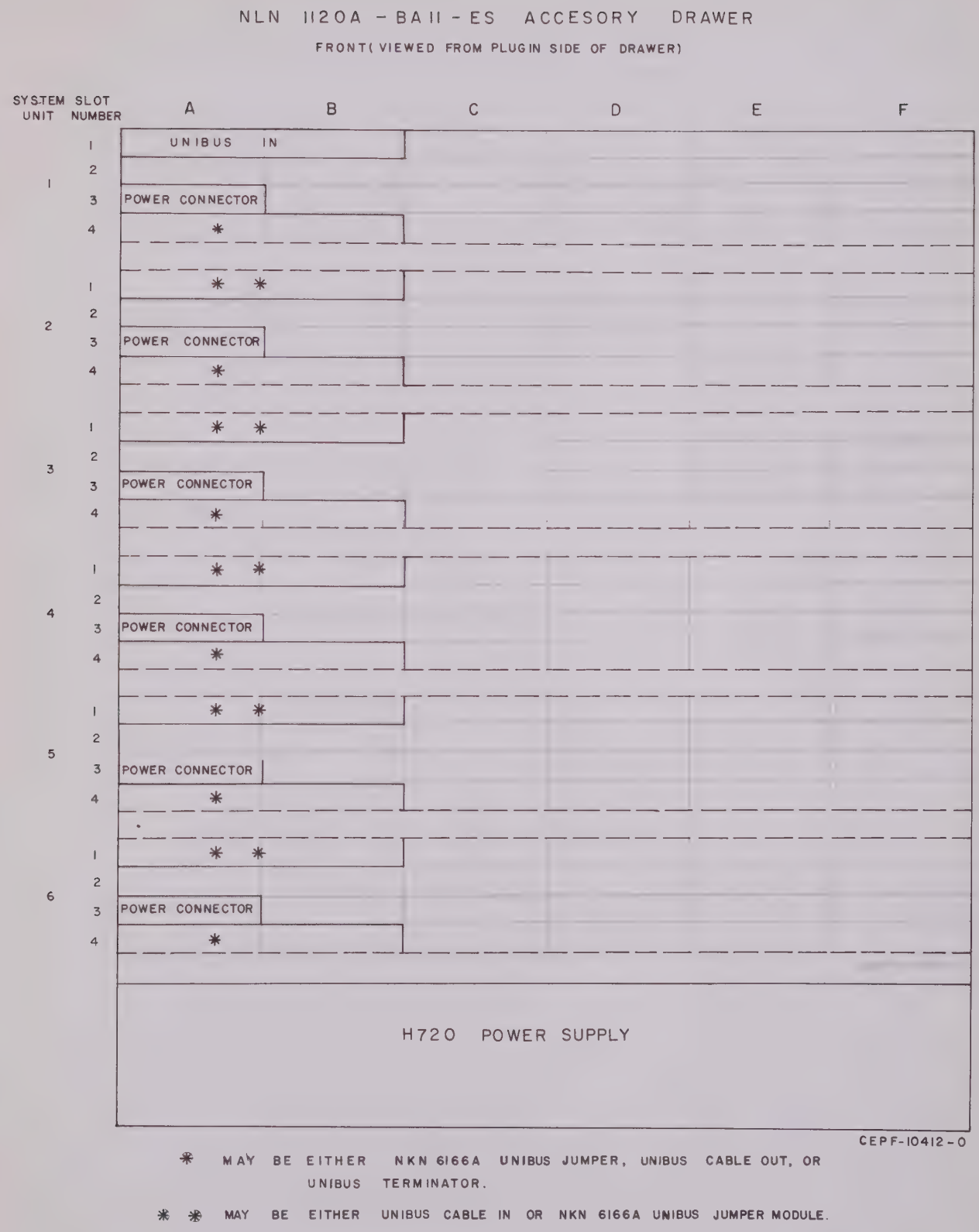


Figure 8-6. Accessory Drawer Layout

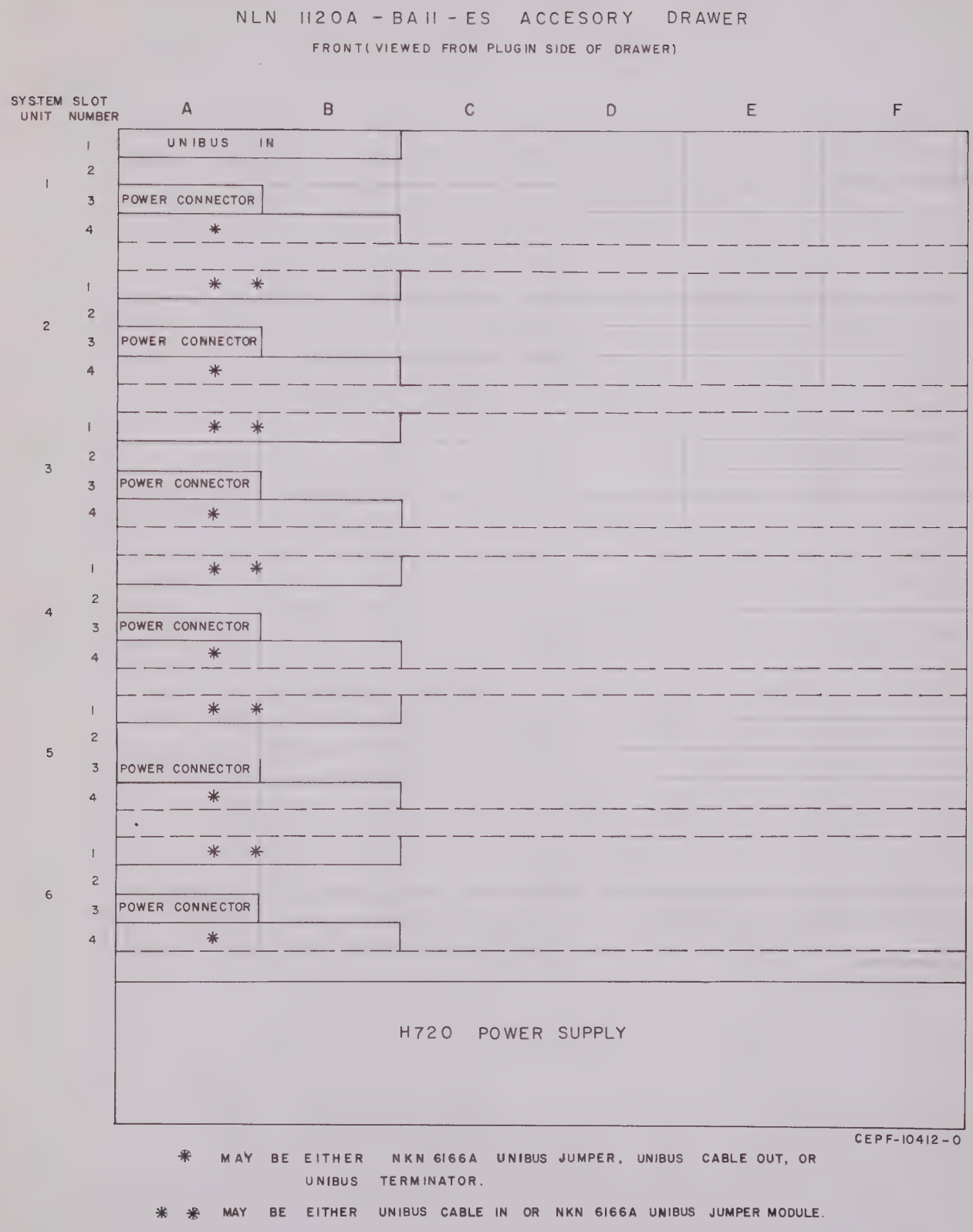


Figure 8-6. Accessory Drawer Layout

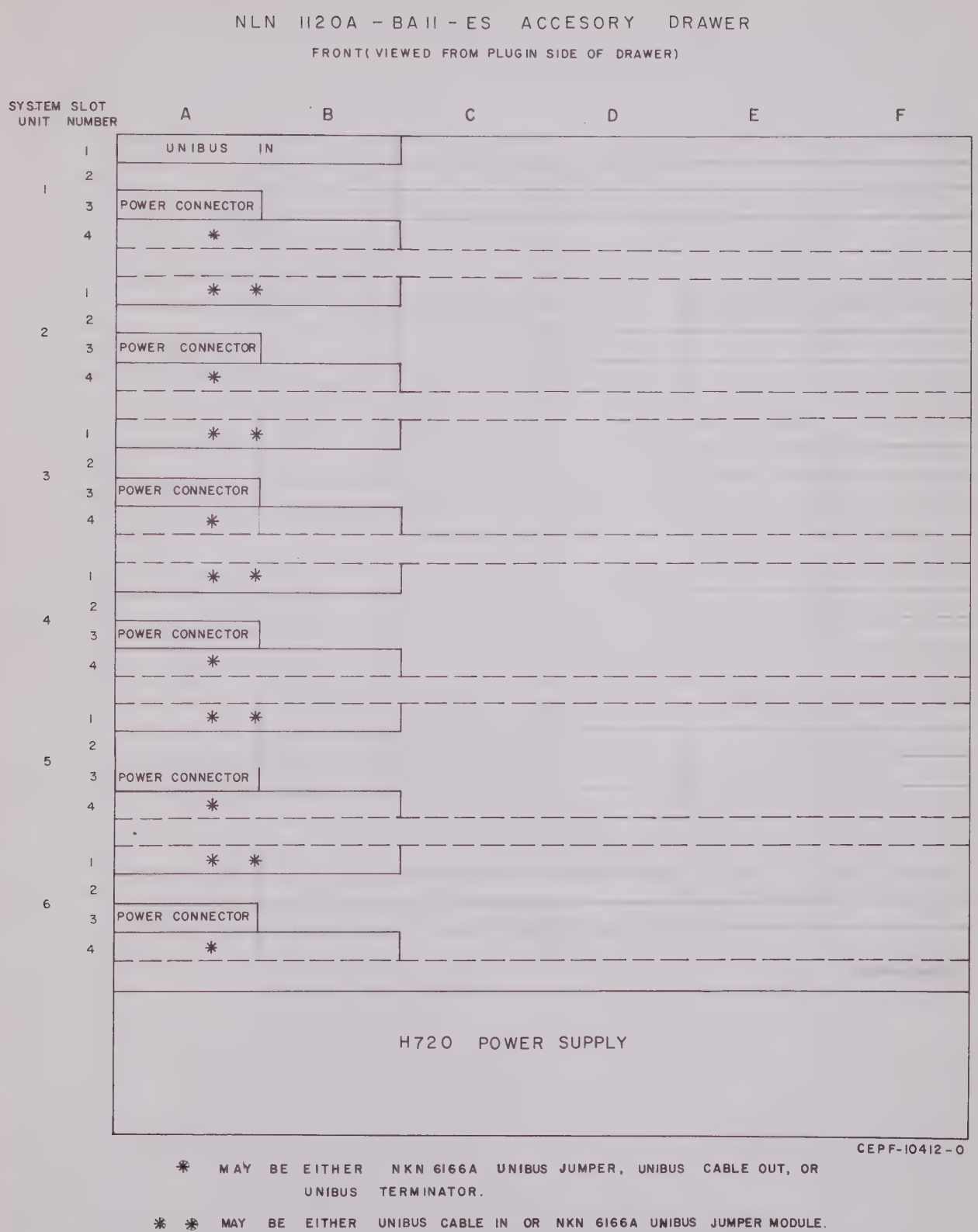


Figure 8-6. Accessory Drawer Layout

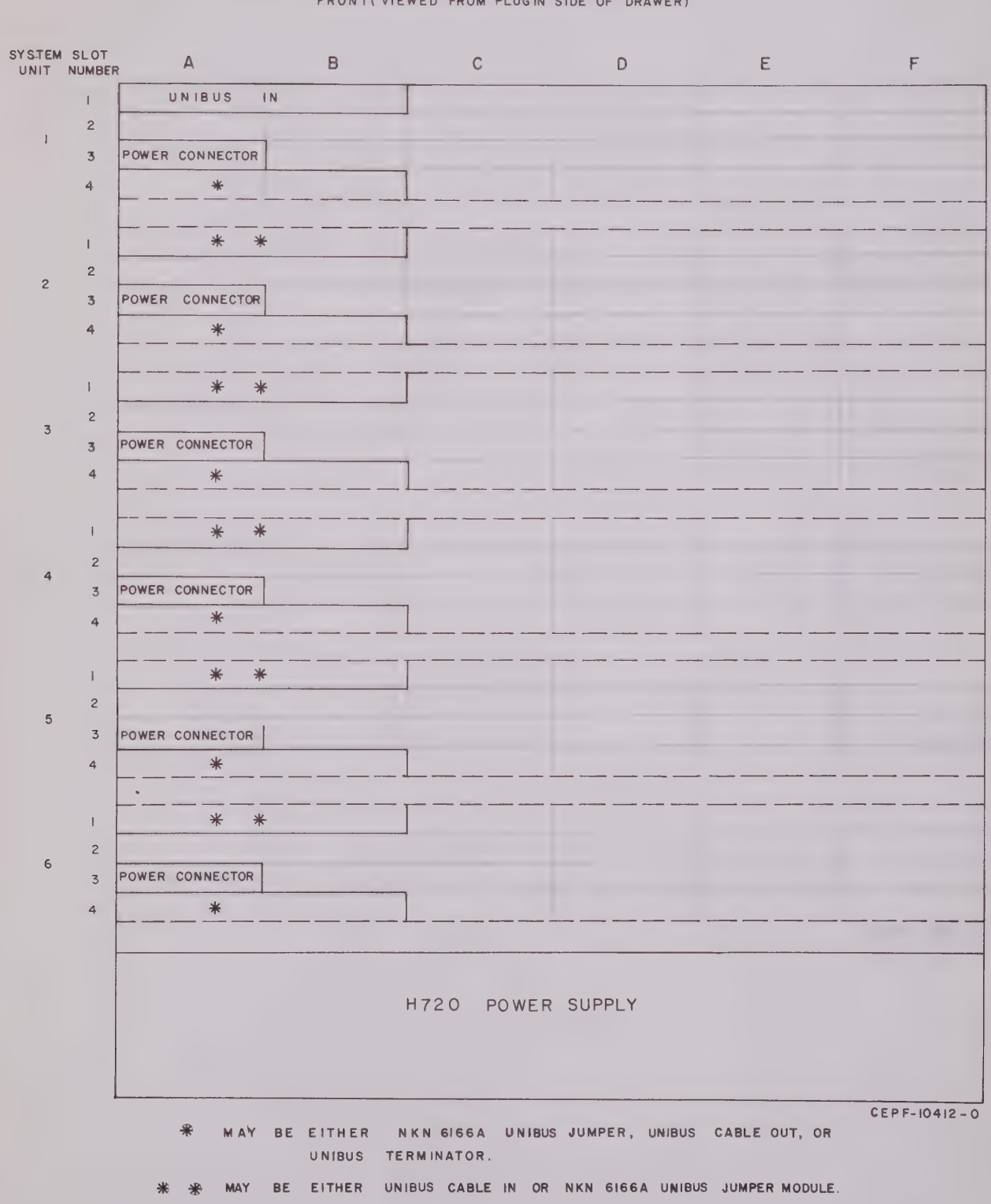


Figure 8-6. Accessory Drawer Layout

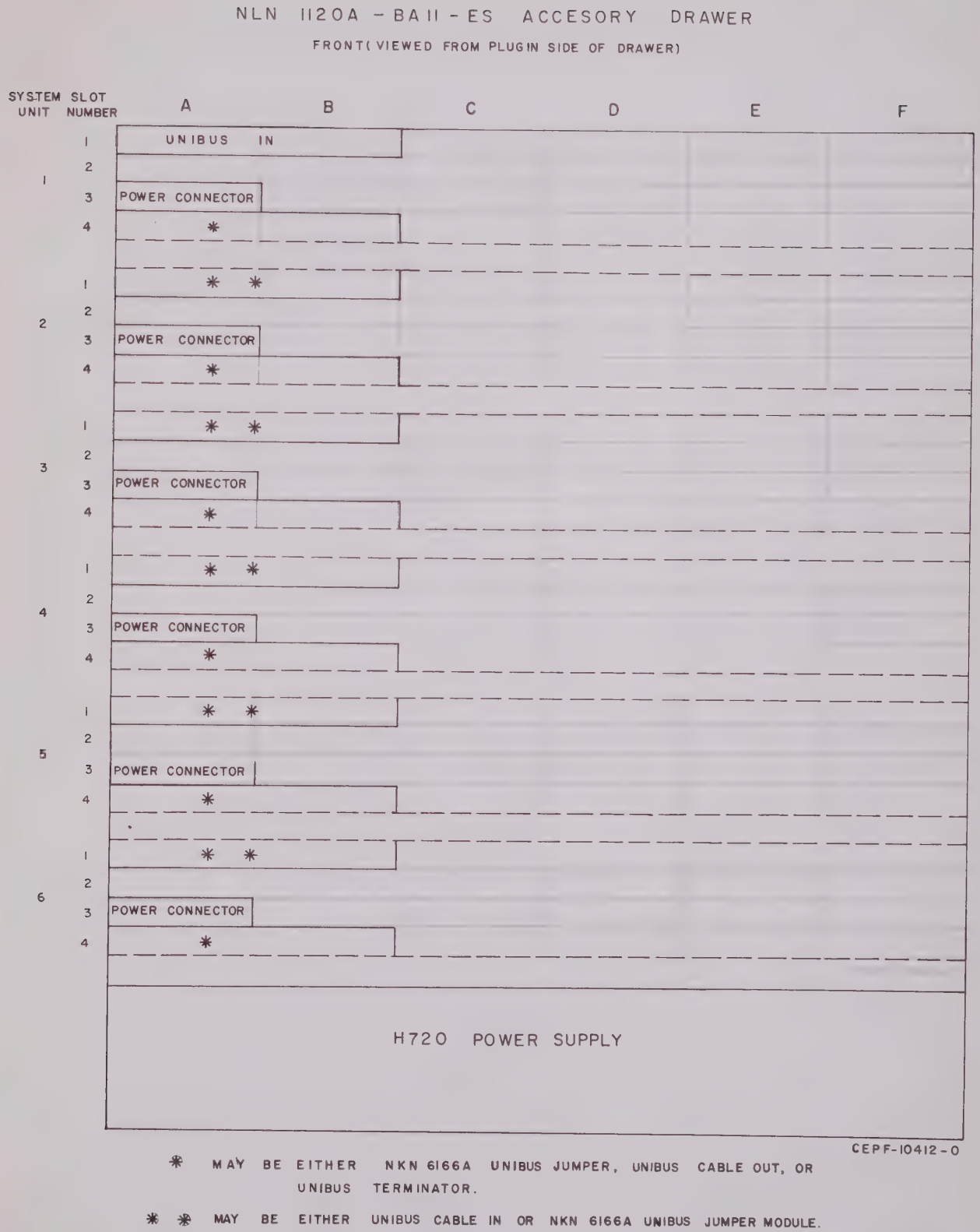


Figure 8-6. Accessory Drawer Layout

APPENDIX A
PHASE EQUALIZATION PROCEDURE (FOR TONE/DC TCU's)

The following represents a detailed step-by-step procedure for equalizing the absolute phase delays in a multiple transmitter paging system using the NLN1261A Phase Equalizer Kit for delay insertion.

1. Obtain a good map of the area under consideration. Mark the map as shown in Figure A-1, indicating the paging terminal, the location of each transmitter, and the monitor receiver site. Mark the transmitter coverage area contours on the map as is customary when a system is engineered. Locate the areas of possible system degradation due to a receiver not being captured by either of two adjacent coverage areas. In Figure A-1, these "no capture" areas are represented by cross hatching.

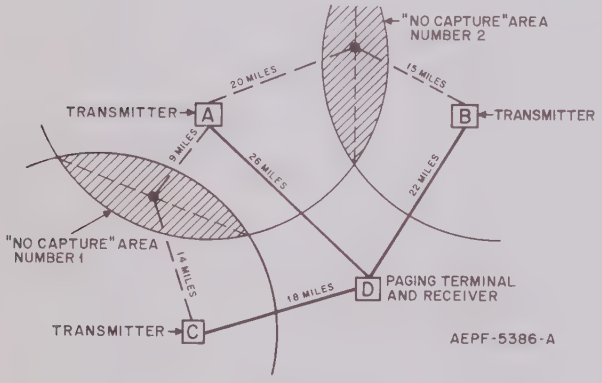


Figure A-1.
Multiple Transmitter Paging System Example

2. For ease of operation, the best location for the monitor receiver is at the paging terminal site. However, the monitor should be situated where all transmitters under test can be received adequately. If the monitor receiver is located somewhere other than the paging terminal, telephone or two-way radio communications should be available.

3. Connect the Motorola-type test equipment as diagrammed in Figure A-2. Monitor the audio oscillator output on one trace and the recovered audio from the monitor receiver on the other trace of the dual-channel oscilloscope. Be certain to use the same monitor receiver for all measurements so that any error introduced by the receiver will be constant for all tests. Also, be sure the oscilloscope is isolated from ground.

4. Set the audio oscillator to a test frequency of 300 hertz and key-on the first transmitter in the system. Superimpose the two traces on the screen of the oscilloscope and adjust their amplitudes until they are equal. Adjust the audio oscillator frequency slightly until the original audio output from the oscillator and the recovered audio are exactly in phase or exactly 180 degrees out of phase. After recording the frequency at which this happens, slowly increase the oscillator frequency until the next in-phase or 180 degrees out-of-phase condition is obtained. After noting the frequency at which the second condition occurs, continue the process until the oscillator output frequency exceeds 2000 hertz. Enter the data obtained in the first column of a table such as that depicted in Figure A-3. During this procedure, observe the oscilloscope closely to make certain that you are actually recording each 180 degree phase shift that occurs in the recovered audio between 300 and 2000 hertz. It may be necessary to adjust the oscilloscope amplitude periodically to facilitate observing the phase coincidence and reversal.

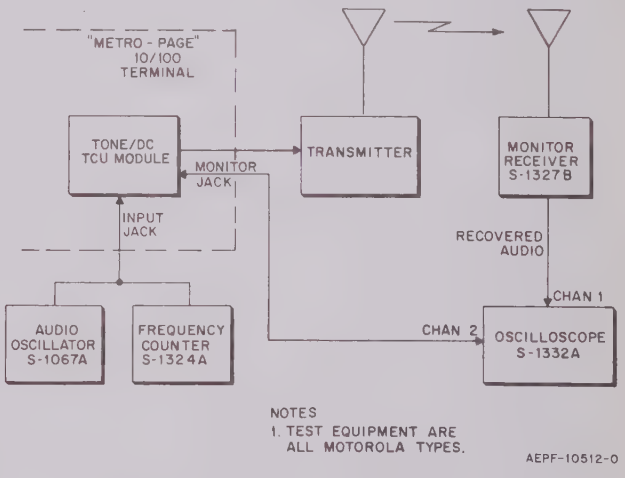


Figure A-2. Test Equipment Setup

5. Repeat Step 4 for all transmitters that are simulcast together.

6. After obtaining all the data, plot the information in the table (Figure A-3) onto a graph similar to that shown in Figure A-4, which assumes a system with three transmitter sites. Draw the best possible line that fits the points, trying to minimize the amounts by which some of the points miss the line. For the purposes of this graph, one cycle is equivalent to 360 degrees, 0.5 cycle = 180 degrees, 0.1 cycle = 36 degrees, etc. The slope of the line drawn through the plotted points gives the absolute phase delay of the the signal path to that particular transmitter. To measure the absolute phase delay in microseconds use the following equation: Absolute Delay (seconds) = (Phase at 2000 Hz — Phase at 1000 Hz)/1000. Using this equation, calculate the

delays for each of the transmitters under test. For example, referring to the graph in Figure A-4 and using the plotted line for transmitter A, the delay is: (4.45 - 1.80)/1000 = 2.65/1000 = .00265 seconds. Converting this to microseconds yields an absolute delay of 2650 microseconds. The values obtained at this point are "uncorrected" delays which will have to be modified in accordance with the distance to each transmitter site. Enter the uncorrected delay values in another table as depicted in Figure A-5.

7. From the uncorrected delay values for each transmitter, subtract the rf propagation delay time from the transmitter to the monitor receiver; i.e., caluculate a correction factor based on the distance between the transmitter and the receiver. The following formula will facilitate this calculation: Correction Factor (microseconds) = 5.4 x distance (miles). Enter the correction factor for each transmitter in the table (Figure A-5).

8. To the corrected delay values for each transmitter, add a second factor which takes into account the rf propagation delay time from the transmitter to the center point of the "no capture" region (Figure A-1). The following formula will facilitate this calculation: Delay Factor (microseconds) = 5.4 x distance (miles). Enter the correction factor for each transmitter in the table (Figure A-5).

9. The overall equation for the final delay value is the following: Final Delay Value = Absolute (uncorrected) Delay — Correction Factor + Delay Factor. The object of this whole procedure, then, is to attempt to get the final delay values for all the transmitters in the system equal. To do this, determine the final delay value for each transmitter in the system and enter these values in the table (Figure A-5). Using the transmitter with the longest delay (highest final delay value) as the reference value, determine the amount of delay which must be added to the other transmitter paths to make their final delay value equal to the one with the highest value in the table. Since the smallest increment available on the audio delay line is 50 microseconds, a system resolution of ±25 microseconds is possible. Using the data in the table (Figure A-5), insert the required amount of delay for each transmitter using the phase equalizer kit.

10. Repeat the measurements of the foregoing procedure and record the results. The results of this second set of measurements (with the added delay elements included in the various transmitter paths) should indicate that the relative phase vs. frequency plots (Figure A-4) very nearly coincide; i.e., the phase vs. frequency curves should be capable of being superimposed on one another with no more than ±0.1 cycle (+36 degrees) discrepancy between them.

FREQUENCY / PHASE RELATION	XMTR A (Hz)	XMTR B (Hz)	XMTR C (Hz)	XMTR D (Hz)	XMTR E (Hz)	XMTR F (Hz)	XMTR G (Hz)	XMTR H (Hz)
IN PHASE								
180° OUT								
IN PHASE								
180° OUT								
IN PHASE								
180° OUT								
IN PHASE								
180° OUT								
IN PHASE								
180° OUT								
IN PHASE								
180° OUT								
IN PHASE								
180° OUT								
IN PHASE								
180° OUT								
IN PHASE								
180° OUT								

Figure A-3. Measured Phase Delays

EPF-5388-O

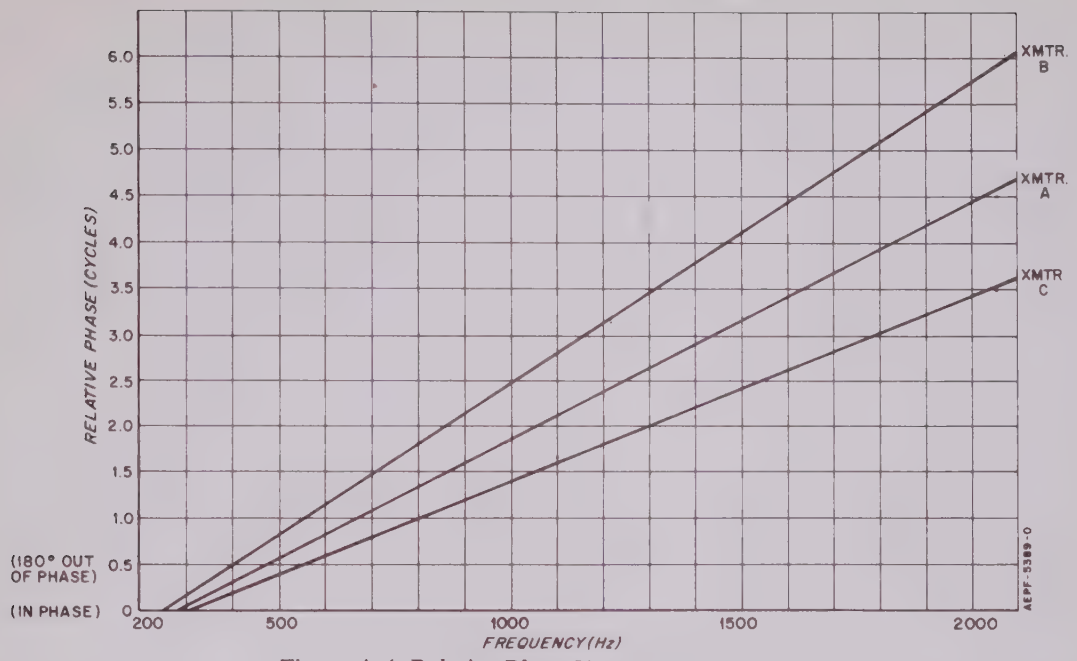


Figure A-4. Relative Phase Vs. Frequency Graph

PARAMETER	XMTR A (us)	XMTR B (us)	XMTR C (us)	XMTR D (us)	XMTR E (us)	XMTR F (us)	XMTR G (us)	XMTR H (us)
UNCORRECTED DELAY FROM GRAPH								
LESS PROPAGATION TIME, RECEIVER TO TRANSMITTER								
PLUS PROPAGATION TIME, TRANSMITTER TO EQUALIZATION POINT								
DIFFERENCE BETWEEN THIS XMTR AND THE MAXIMUM FOR THE SYSTEM. THIS IS THE DELAY TO BE ADDED.								
AMOUNT OF DELAY ADDED								
REMEASURED DELAY METER EQUALIZATION								

Figure A-5. Delay Correction Calculations EPF-5390-O

APPENDIX B
PHASE EQUALIZATION PROCEDURE (FOR BINARY TCU's)

The following represents a detailed step-by-step procedure for equalizing the absolute phase delays in a multiple transmitter paging system using the NLN1261A Phase Equalizer Kit for delay insertion. Basically, the procedure involves the calculation of delay values for each transmitter, finding the transmitter with the longest delay, and adding delay to the other transmitters to make all delays equal.

1. Obtain a good map of the area under consideration. Mark the map as shown in Figure B-1, indicating the paging terminal, the location of each transmitter, and the monitor receiver site. Mark the transmitter coverage area contours on the map as is customary when a system is engineered. Locate the areas of possible system degradation due to a receiver not being captured by either of two adjacent coverage areas. In Figure B-1, these "no capture" areas are represented by cross hatching. Label the transmitters A, B, C, etc. and the "no capture" areas 1, 2, 3, etc.

2. (a) In order to measure absolute delay accurately, it is necessary to have a fixed reference to which the received signals from the transmitters can be compared. For this reason, if at all possible, the delay measurements should be made at the terminal sight using TP2 (Binary Data) on the appropriate binary output unit as reference. Figure B-2 shows the equipment setup if the procedure is to be performed locally. The appropriate edge of Binary Data will trigger the scope. This same edge will be visible on the scope at some later time. This delay in receiving the edge is equal to the uncorrected delay value. Either edge can be used to trigger the scope, but the same edge should be used for all measurements.

(b) If it is not possible to make the necessary measurements at the terminal, the setup shown in Figure B-3 must be used. When making delay measurements, only one transmitter (and therefore one TCU) is activated at any time. All other TCU's are off. One of the unactivated TCU's is used to transmit the mark and space frequencies to the receive modem at the remote site, and the demodulated output is used as the reference. This is done by running an extra phone line from the remote receive modem to the terminal. The phone line on one of the unactivated TCU's is removed and replaced by the extra phone line. This method of measurement will work only if the delay over the transmitter phone line is greater than the delay over the extra phone line. Otherwise the edge will not be visible on the scope since the scope will be tiggered after the edge occurs. If the delay over the extra phone line is greater, then the output from the receive modem should be connected to channel 1 of the scope and the recovered binary data from the monitor should be connected to the external trigger. Note that since the recovered binary data occurs *before* the reference, the delay recorded will be *negative*.

Since one man will be necessary at the terminal to operate the system, 2-way communication equipment must be provided between the terminal site and remote location.

3. Once measurements begin, the position from which the measurements are taken should not be changed. Formulas to compute the delay values have correction factors added in order to correct for rf propagation delay. Any change in position will make the correction factor values invalid. Also, be certain to use the same monitor receiver for all measurements so that any error introduced by the receiver will be constant for all test.

4. Below is the procedure for carrying out the delay measurements.

(a) Set all MAINTENANCE/OPERATE switches on MTB/ATB J19 to MAINTENANCE POSITION on system half that will be used for testing.

(b) Halt Processor,

Load address 160300_8	Deposit 000040_8
	Deposit again
	Exam
	Deposit
	Exam
	Deposit
	The binary output unit should sequence through a single page and then send continuous comma.

(c) Set the "TCO/OP/ON" switch on all binary TCU's except the one connected to the transmitter whose delay is being measured to "TCO."

(d) Set the "TCO/OP/ON" switch on the TCU being used to transmit the reference signal to "on."

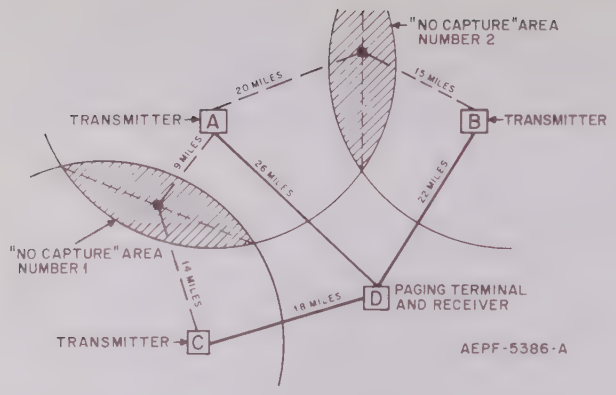


Figure B-1 Multiple Transmitter Paging System Example

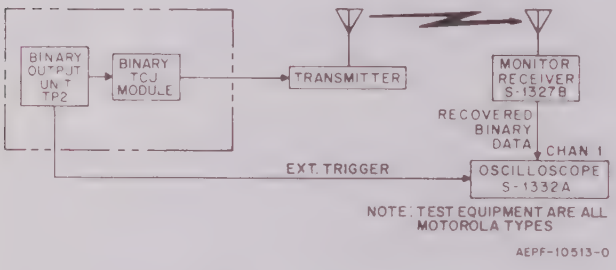


Figure B-2 Test Equipment Setup (Local)

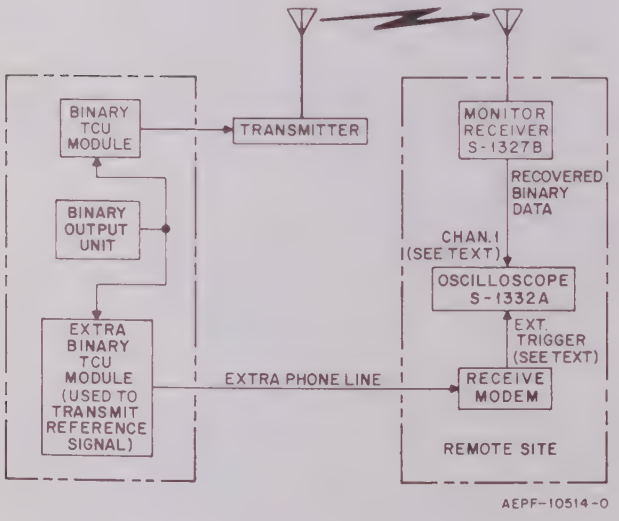


Figure B-3 Test Equipment Setup (Remote)

(e) After delay, the monitor receiver will receive this change in data, demodulate it, and apply it to channel 1 of the scope. This edge should be visible on the scope. The time base of the scope should be set for 1 mS/div initially. When the edge is seen, the time base can be changed for a more accurate measurement. Note the edge and the scope time base (time/div), and from that, calculate the uncorrected delay value (i.e., the value before the rf propagation effects are taken into account). When measuring delay, the recovered binary data has to be demodulated through a modem. This can introduce up to a 165-microsecond error (due to "jitter"), and thus, degrade the delay measurements. However, by taking 10 measurements of the delay and averaging them, the inaccuracy due to jitter will be averaged out. Record the value in Table B-1. If using a remote setup and no edge can be seen, the problem could be that the delay though the extra phone line is greater than that of the recovered binary data; therefore, try triggering the scope of the recovered binary data and look at the reference signal on the scope. (Don't forget to record this as a negative delay.)

(f) Repeat paragraphs (c) through (e) for all transmitters, (that are simulcast together) each time recording the uncorrected delay in Table B-1.

5. The following paragraphs are used to correct the delay measurements in Table B-1 by considering rf propagation delay. There are two correction factors:

Table B-1. Uncorrected Delay Measurements

Transmitter	Delay (uS)
A	
B	
C	
D	
E	
F	
G	
H	

(a) From the uncorrected delay values for each transmitter (Table B-1), subtract the rf porpagation delay time from the transmitter to the monitor receiver; i.e., calculate a correction factor based on the distance between the transmitter and the receiver. The following formula will facilitate this calculation: Correction Factor (microseconds) = 5.4 x distance (miles). Enter the correction factor for each transmitter in Table B-2.

Table B-2. Correction Factor Values

Transmitter	Correction Factor (uS)
A	
B	
C	
D	
E	
F	
G	
H	

(b) Calculate a second factor which takes into account the rf propagation delay time from the transmitter to the center point of the "no capture" region. Note that some transmitters transmit into more than one "no capture" region. For these transmitters, there will be one of these correction factors for each of the "no capture" areas to which the particular transmitter transmits. For example, in Figure B-1, only one of these

correction factors is needed for transmitters B and C; however, two correction factors are needed for transmitter A, one for each "no capture" area to which it transmits. The following formula will facilitate this caluculation: Delay Factor (microseconds) = 5.4 x distance (miles). Enter the delay factor for each transmitter in Table B-3. The table has eight columns for eight "no capture" areas. There may be more or less of the areas. Table B-3 and the following Table B-4 are examples only; full-size work tables are given at the end of this appendix.

Table B-3. Second Correction Factor (Delay Factor)

Transmitter	"No Capture" Area No. 1 2 3 4 5 6 7 8
A	
B	
C	
D	
E	
F	
G	
H	

NOTE

If transmitter does not transmit to a particular "no capture" area, leave entry in table blank.

6. The overall equation for the corrected final delay value is the following: Final Delay Value = Absolute (uncorrected) Delay — Correction Factor + Delay Factor. Note that the number of Final Delay Values for any transmitter is equal to the number of "no capture" areas to which the transmitter transmits. In Figure B-1, transmitter B and C will have one Final Delay Value; transmitter A will have two. Calculate Final Delay Values for all transmitters and record them in Table B-4. If transmitter does not transmit to a particular "no capture" area, leave the table entry blank. The table has eight columns for eight "no capture" areas. There may be more or less of these areas.

Table B-4 Final Delay Values

Transmitter	"No Capture" Area No. 1 2 3 4 5 6 7 8
A	
B	
C	
D	
E	
F	
G	
H	

7. The following is the procedure for using Table B-4 to determine the delays to be added to phase equalize the system.

(a) Look at every entry in Table B-4, and find the largest final delay value.

(b) Add appropriate extra delay values to all other values in the particular column that this largest value is found so that all values in the column are equal. By adding this extra delay value, the phase will be equalized at the "no capture" area corresponding to this column.

(c) Note the rows where these extra delay values appear. Since each row is associated with a transmitter, this same extra delay must be added to each element in that row. This operation changes some of the final delay values to new values.

(d) Next look at all entries in Table B-4 other than those entries in the column just equalized, and find the entry with the largest delay value.

(e) Again add appropriate extra delay values to all other entries in the column that the entry found in paragraph (d) appears. The "no capture" area corresponding to this column is now equalized.

(f) Note the row where these extra delay values appear, and add this same delay value to any element in that row.

(g) Look at all entries in Table B-4 other than the entries in the columns that have been equalized, find the entry with the largest delay value, and repeat paragraphs (e) and (f). Repeat the procedure until all "no capture" areas are equalized.

(h) Every row in Table B-4 will have a particular extra delay value associated with it. This is the delay that must be inserted on the TCU that is connected to the particular transmitter associated with that row. Since the smallest increment available on the audio delay line is 50 microseconds, a system resolution of ±25 microseconds is possible, therefore round all the delay values to the nearest 50 microseconds.

(i) For each TCU that is to have delay added, remove jumper JU5 on the TCU board. Set the Phase Equalizer to the desired delay value, and connect its input to P18 on the TCU 44 pin connector and its output to P19.

8. To check that the procedure has been done correctly, repeat Steps 2 through 6 with the Phase Equalizer kits installed. Using this procedure, final delay values for any "no capture" area can be set to within 50 microseconds of each other; however, the system is considered phase equalized if the delays are within 330 microseconds of each other.

9. Example:

(a) Refer to Figure B-1. It is desired to phase equalize this system. Following the procedure in Step 4, suppose that the uncorrected delay values are as follows:

Transmitter	Delay (uS)
A	2000
B	2500
C	1700

Next, correction factors must be calculated (Step 5. a).

Transmitter	Correction Factor (uS)
A	5.4 x 26 = 140.4
B	5.4 x 22 = 118.8
C	5.4 x 18 = 97.2

Next, the delay factors are calculated (Step 5. b).

XMTR	"No Capture" Area No. 1	"No Capture" Area No. 2
A	5.4 x 9 = 48.6 uS	5.4 x 20 = 108 uS
B	—	5.4 x 15 = 81 uS
C	5.4 x 14 = 75.6 uS	—

Therefore final delay values would be as follows (Step 6):

XMTR	"No Capture" Area No. 1	"No Capture" Area No. 2
A	2000-140.4 + 48.6 = 1908.2 uS	2000 - 140.4 + 108 = 1967.6 uS
B	—	2500-118.8 + 81 = 2462.2 uS
C	1700 - 97.2 + 75.6 = 1678.4 uS	—

Following the procedure of Step 7, it is seen that 2462.2 uS is the largest element. Therefore 494.6 uS of delay must be added to transmitter A to make the delays in column 2 equal (i.e., 1967.6 uS + 494.6 uS = 2462 uS). Since 494.6 uS must be added to transmitter A, the new final delay value of transmitter A to "no capture" area 1 equals 1908.2 uS + 494.6 uS = 2402.8 uS. Now going to "no capture" area 1, 724.4 uS of delay must be added to transmitter C to make the delays equal (i.e., 1678.4 uS + 724.4 uS = 2402.8 uS). This data is summarized in the following table:

XMTR	"No Capture" Area No. 1	"No Capture" Area No. 2
A	1908.2 (+ 494.6)	1967.6 (+ 494.6)
B	—	2462.2
C	1678.4 (+ 724.4)	—

Therefore, the TCU controlling transmitter A should have a delay equalizer set for 500 uS (rounding 494.6 uS); the TCU controlling transmitter C needs a delay equalizer set for 700 uS (rounding 724.4 uS).

XMTR	"No Capture" Area 1	2	3	4	5	6	7	8
A								
B								
C								
D								
E								
F								
G								
H								

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